proposed will have to consider the wide range of operational practices that will be developed during the introductory phases of a DTV service.

- It was suggested that the Audio Group consider the carriage of other data, such as caption data, within the audio path. Other than the discussion noted in the data services section, this issue has not been addressed.
- Since the authoring and editing of audio metadata are new functions, it was not clear how broadcast facilities will handle these functions. The group is making recommendations based on functional considerations but without practical operational input. It is suggested that IS/S1 undertake an effort to define the operational requirements for the authoring and transport of metadata. This effort could also develop the basis for a communications protocol that can be disseminated to providers and users of the metadata.

Conclusions

Considering that

- a release or distribution format for DTV programming will have to carry six audio channels
- and that the affiliate's audio distribution system should carry both a six channel and a two channel (either stereo or Dolby Surround encoded) sound track for NTSC release
- and that a signal path for the metadata has to be provided
- and that the Affiliate stations are unlikely to significantly expand their audio distribution systems then

1. Some form of Contribution quality audio coding scheme is needed in order to be able to use the existing audio distribution infrastructure for ATSC audio.
2. These conclusions are reinforced by the statements in the "Different Approach for Audio" paragraph of the Multiple Video Format report.
3. The transport mechanism of item 2 should also provide a path for the metadata needed to make the ATSC audio system full functional.

Control Plane

Introduction

The data and control areas have been among the last to be recognized and developed in the design process for DTV and in the "transition to digital" in the industry as a whole. Early work concentrated on video and audio issues and recognition of the significance of metadata; it has not been until relatively recently that the critical need for an integrated control plane design as part of the move to DTV was generally understood.

In order to permit broadcasting in DTV with the same flexibility and capability that currently exists in analog television broadcasting, a large number of commands, parameters, and responses must be passed among devices, going far beyond current designs which accomplish only relatively basic machine control. For example, it has been estimated that changing format from a single HDTV program stream to multicasting several SDTV program streams can require changes to as many as fifty parameters in the encoder and multiplexer subsystem alone, with several such control salvos potentially required to fully transition from one mode to the other. All these parameter changes must be precisely synchronized in their execution if a seamless transition is to be presented to the viewer.

Methodology

The Control Plane working group consisted of a team of interested individuals drawn from a mix of equipment manufacturers, broadcasters and related industry representatives. The work began with an examination of the Top Down drawing, version 4, from which the team developed its own Control Plane drawing dealing specifically with control issues. This drawing, Attachment E, was an output from the first session, breaking control into two levels, depending on the complexity of the control and status information being transferred. The interconnections between devices are not shown, as they will follow the logic of the control network and may have little relationship to the signal flow on other planes.

The Low Level Control represents roughly the type of control over machines achieved currently, generally using low speed networks. The High Level Control represents the type of control expected in future systems using high speed networks and distributed object models.

In addition, conceptual control elements consisting of an Operator, System Scheduler, Facility Resource Manager and Status manager were added. These were intended to represent the increased functionality to be provided by a hierarchical system of processors that could support sufficient automation to make the increased complexity of future systems appear transparent to operators.

As part of the second session, the same drawing was used as the basis for discussion, with the added emphasis that the top half of the drawing was assumed to be the current and future NTSC plant, with the lower half the overbuild of a DTV facility.

The group determined to first concentrate on those elements absolutely required to move to DTV, since most elements of basic machine control are already well understood and in place as part of today's NTSC implementations.

Discussions and Findings

Low Level Control was understood to be standard control as done today at 38Kb/s, for example. High level control was described as derived from current computer-based control for such things as automation. Low level control might deal with individual devices, high level control would prioritize and use both low and high level links.

The presumption is that DTV will require a new level of automated control to permit transitions in a seamless manner. This leads to hierarchical control, which will permit future expansion and multiple levels of control for both small and large stations.

It was also recognized that there were three fundamental functional areas within a television station, more or less in signal flow order. These are the production function (including post production) in the "Input" area, the storage and playback function in the "Baseband" area, and the transmission function in the "RF" area, which includes everything following the release switcher. The first of these currently requires very little automation control. The second is already highly automated and controlled, with a few notable exceptions for new devices that will have to be included in future systems. The third has not required control or automation in the past but will have to be highly controlled in the future. Thus the group elected to concentrate its efforts in the third area, where almost nothing exists and the most will be needed in the future.

In its work, the SMPTE-EBU Task Force has determined to use an object model for control. A similar model follows for content. "Object model" implies that all devices have an address, and the Task Force is working on a higher level to develop the specifications and standards for this model.

The group determined that it should work to identify equipment that needs to be modeled, and to identify the functionality that will require control and appropriate protocols for use with these devices. It is understood that present equipment manufacturers are currently working at lower level, and several protocols exist to communicate among devices, often in a proprietary manner. The group's efforts were directed towards identifying a level of commonality, which must exist among devices to enable common control over them.

Some devices will require time-aware control, where rapid communication and response is a necessity. Higher level control will be less time-significant, where information may be provided well ahead of activation. The control model was consequently divided into three temporal levels of control:

1. Level 1 – Systems dissociated from time, which communicate to time-aware devices (time frame of minutes or greater)
2. Level 2 –Time-aware devices (time frame of one video frame, or so)
3. Level 3 –Instantaneous response devices (time frame of microseconds).
4. Each class of device at any level will have its own set of attributes, and manufacturers may choose to implement proprietary interfaces among devices in any level.

See Appendix 4 for currently identified devices and aspects which require control.

Issues Pending

This group expects that over the next 12-18 months there will be proprietary solutions and perhaps an approach of using a monitor/keyboard per device until integrated approaches are fully identified and standardized. The group agrees that object models are preferred for implementation as described in the report of the Joint SMPTE / EBU Task Force.

Action Items

Further work is needed to identify devices and their attributes in the "Baseband" and "Input" classes. The attributes of all these devices then should be placed into an object model for control. These elements, devices and their control requirements then need to be integrated into a schedule and resource manager for high-level control.

Timing Plane

Frame Rate

For the foreseeable future, stations will have an obligation to continue NTSC service. In the near term, this service will provide a preponderance of the station's revenue. It is impractical to operate a single facility at 59.94 Hz and 60.00 Hz-based frame rates simultaneously. Therefore, IS expects that all broadcast facilities will operate at 59.94 Hz-based frame rates, and they will expect program material to be supplied to them at these rates.