Findings

As the functionality of inputs and outputs of the station are relatively known and well-defined, this group was able to complete and document a full inventory of standards that are utilized in the station.[3] In the process, a number of functions, particularly in addressing legacy audio issues were added to the original diagram. It was also noted that while the map shows separate functional blocks for the 8VSB exciter and the DTV transmitter, these are typically purchased as a single unit from a given vendor and does not typically lead to mix-and-match interoperability issues.

Strawman Implementations

For studio facilities that are co-located with their transmitter, legacy standard cabling should allow for connection of the ATSC multiplex output to the transmitter. For studio facilities that are remote from the transmitter facility, two possible implementation scenarios were identified. The first method is to not make any modifications to the NTSC feed, maintaining delivery of that signal over its standard analog microwave link. In this case the HD feed could be delivered over a separate microwave channel, or potentially over fiber to the transmitter facility. The second method identified would multiplex the NTSC and HD feed so that a single communication channel could link the studio and transmitter facilities. It was noted that there are several manufacturers providing equipment for such a link.

Issues for Further Consideration by IS

The group identified that further work is needed to specify the format and data rate of material provided by the network or other program suppliers. This specification should insure that sufficient quality is delivered in contribution links to enable processing within the station.

As latency issues can be substantial for compressed feeds, work should be undertaken to provide a method of adding a cue (Pro) channel audio source to the bit stream as a separate private data stream for cueing of remote crews. If low enough latency cannot be obtained, a separate audio return path may be needed.

Data Services

Introduction

While broadcasters have had the ability to deliver data services in the Vertical Blanking Interval of their current transmissions, one of the intriguing factors of the advanced television standard is its ability to deliver a wide range of new and future data services through the multiplexed transport. While these data services may represent a range of new capabilities and business models, many details for both the functional and detailed implementation have yet to be determined.

There is a need to define the interfaces over which data signals will be carried in a DTV station. Both physical interfaces and signal protocols need to be defined and the relevant standards need to be referenced. If standards do not exist, the need for their development must be articulated.

[3] As noted elsewhere in this report, while physical and electrical interfaces are well documented, further work to specify the format and data rates of the various inputs and outputs to the station must be done.

Scope of Effort

In developing a Strawman Data Plane for a DTV station, the Data Group limited its scope to consideration of only those data signals that are part of the final emitted signal. These include both content (e.g. closed caption signals) and system data (e.g., PSIP). These data signals may come from a variety of sources, including real-time delivery by the network (e.g. closed captions or network-originated data broadcasts) as well as locally generated closed captions and data broadcasting content. Data broadcasting content may be either program-related or non-program-related. Another source of broadcast data signals is data extracted from the station's NTSC signal. With respect to the system data signals, PSIP, etc., the data group did not include in its scope the manner in which these signals are obtained, processed and provided as inputs to the PSIP generator. These functions were considered to be part of the management and control planes. There is also a need for a number of interfaces to the management system for the extraction of this data from the network feed and/or from the station's traffic computer or other sources, and finally deliver it as input to the PSIP generator.

Methodology

After review of the top down map, a new diagram (see Attachment B) showing only the data plane and its direct connections to the other elements of the DTV station was developed. This simplified view makes it easy to see the data paths and the points where they interface to other components, e.g., the video encoder and the ATSC Multiplexer. The Conditional Access components were omitted from this simplified diagram, since it is not likely that they will be included at the outset of early station implementations.

To facilitate the discussion of various functional requirements and their implementation the notion of a data bridge was created. This functional block represents somewhat of a clearing house for the collection and dissemination of various data through the station. While it is unclear whether such a data bridge will be offered or implemented, it provided a useful framework for our discussion.

Findings

The Data Group considered 4 types of data:

- Picture user data
- Program-related data carried on separate PID
- Non-program-related data carried on separate PID
- System data

Picture User Data

Picture user data (e.g. closed captioning) inserted into the stream by the video encoder can be sourced either by the data bridge or extracted by the video encoder from Ancillary data in the incoming digital video (e.g. SMPTE 259/292). If the data bridge is sourcing the data, it is assumed that synchronization will occur within the data bridge so that the data to the encoder appears simultaneously with the appropriate video frame. The format of the closed caption data is per EIA-708. The lower layers of the protocol stack (embedding format in SDI, AES-3, RS-232, Ethernet, RS-422, etc.) are left to be determined.

Program-Related Data

Program-related data splits into two types: synchronized data (requires PTS) and non-synchronized data. Synchronized data is muxed in through the program mux, unless it already has a reference PTS. Non synchronized data can be muxed either through the program mux or the ATSC Emission Mux. In either case, this data comes from the Data Server. The requirement for presenting the data at the appropriate time to either mux is the responsibility of the Data Server. The format of this data is MPEG-2 Transport Packets, carrying T3-S13/T3-S16 protocols. The physical data link can be either DVB ASI, SMPTE 305M or Ethernet (with recognition of specific constraints in the case of Ethernet).

Non-Program-Related Data

The Data Server presents non-program-related data directly to the ATSC Emission Mux. The requirement for presenting data at the appropriate time to the mux is the responsibility of the Data Server. The format of this data is MPEG-2 Transport Packets, carrying T3-S13/T3-S16 protocols. The physical data link can be DVB ASI, SMPTE 305M or Ethernet (with recognition of specific constraints in the case of Ethernet).

In cases where remote data servers are used and are connected directly to the ATSC Emission Mux (e.g. there is a connection from the WAN directly to the ATSC Mux), it is assumed that the incoming data stream will be a fully compliant MPEG-2 Transport Stream, complete with PSI. This PSI may need to be extracted and sent to the management plane (see below).

System Data

System data is extracted from the incoming streams (from the network or elsewhere) and passed to the management plane, which is responsible for further handling of this data. This data will need to be combined with locally generated data and data from other sources, e.g. scheduling data. The management plane is responsible for providing the source data for the PSIP Generator, PSI Generator, UPID Generator, CA Generator, etc. In general the processing done by the management plane is not time critical. However, under certain circumstances, the latency through the management plane is important. Responses on the order of 1-2 seconds may be required to deal with last-minute program schedule changes or emergency alerts.

Scrambling

Scrambling is illustrated in the Tops Down diagram as functional block [91]. Its purpose when employed in a broadcast television station is to provide encryption of the digital television signal. To receive an encrypted television signal a set top box or digital television must have a decryption device and the proper authorization. While the Scrambler function is illustrated in the diagram, its final location in the system and its implementation may differ as standards surrounding Scrambling are not yet determined.

Strawman Implementation

A simplified data plane diagram is attached (Attachment C). It shows an NTSC path at the top, which may be either analog or digital, and a digital path at the bottom, which may be either HDTV or SDTV or

a combination of both. The Data Bridge provides an exchange mechanism between the NTSC and DTV plants for data signals. Thus data carried in the vertical interval of the NTSC signal can be extracted by Data Extractor and passed to the DTV plant. Likewise, the Data Inserter can insert data from the DTV plant into the NTSC vertical interval. The Data Server is the "Data Central" of the DTV plant. Except for closed caption signals that travel with the video (SMPTE 259/292) as ANC data packets or in some other TBD format, e.g., AES-3, all data broadcast signals, whether program-related or non-program-related pass through the data server. The processing of PSIP data, other PSI data (PAT and PMT data), UPID data and Conditional Access data is not shown on this diagram. As discussed above this data is processed in the management and control planes. There will have to be interfaces to the management and control planes at various points. Three such interface points are indicated on the diagram by the circled letter M. The interface to the input Demux allows data sent by the network to be delivered to the management and control planes. The interface to the data server allows two-way data communication between the server and the management and control planes; and the interface to the PSIP, UPID and PSI Generator allows the management and control plane to deliver the necessary data to the generator.

Issues Pending

A number of open standards issues were identified:

- Conveying EIA-708 data in SMPTE 259 and 292.
- Conveying EIA-708 data over the data link (RS232, RS422, Ethernet...) from the data bridge to the video encoder.
- Conveying EIA-708 data in AES-3.
- Conveying data from network to local stations over the distribution network.
- Definitions of interfaces to and from the management and control planes.

Issues for Further Consideration by IS

IS should influence the standards-making process with regard to the two critical needs of standards for the closed caption food chain and for the delivery of data from the network to stations over the distribution network. As part of its ongoing work on the control and management planes, IS should give high priority to the interfaces between these planes and the data plane of the DTV plant.

Redistribution Signals

Introduction

While the original scope of effort for the top down map addressed outputs from the station to the transmitter, it was noted that there are a number of other destinations which stations must feed their signal in a variety of formats. A group was assigned the effort to identify these destinations, the data rates that are likely to be delivered, and any functional requirements that must be added to the map to facilitate this redistribution of the station's programming to other facilities.