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PSIP by the numbers

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By now, most broadcasters are probably aware of the Program and System Information Protocol, better known as PSIP. And some may be implementing it in one form or another. This article explores the architecture of PSIP, covers some of the "gotchas," and investigates a few of the issues that may affect the way a station represents itself to the viewer through PSIP.

In brief, PSIP helps viewers receive programs and helps broadcasters represent themselves to the viewers. PSIP displays program information, station branding and program promotional information on an electronic program guide (EPG) generated by the viewer's set-top box (STB). A good working knowledge of PSIP is essential for a station to stand out from the plethora of available ATSC services, and to control the description of its programming.

PSIP is a collection of nine tables that allows the DTV transport stream to provide information about a station's services and programming. These tables are:

- Master Guide Table (MGT)

- System Time Table (STT)

- Virtual Channel Table (VCT)

- Rating Region Table (RRT)

- Event Information Table (EIT)

- Extended Text Table (ETT)

- Data Event Table (DET)

- Directed Channel Change Table (DCCT)

- DCC Selected Code Change Table (DCCSDT)

Figure 1 shows how these tables relate to each other in a typical application. A station may use some or all of these tables, depending on its ATSC service offerings and capabilities.

At the top of the table structure is the Master Guide Table (MGT). The MGT is the roadmap to PSIP tables in the ATSC transport stream. In addition, the MGT provides program-identification (PID) locations so a receiver can find the other tables, and informs the receiver of changes or table updates.

The System Time Table (STT) allows a broadcaster to present GPS time and daylight-savings time indicators to the consumer's STB so that the STB has the same notion of "now" as the broadcaster.

Branding

PSIP provides three important services for the broadcaster as well as the viewer. First, it preserves a station's branding in the transition from NTSC to ATSC. One of the tables in PSIP is the Virtual Channel Table (VCT). Similar to the MPEG-2 Program Association Table (PAT) and Program Map Table (PMT), the VCT identifies associated major and minor channel numbers, tells the receiver whether a broadcaster is broadcasting multiple program channels and, if so, how to find them. In addition to listing virtual channels, the VCT provides a link to the DTV channel's analog equivalent. The purpose of the VCT linkage is to translate a station's branding from the analog RF channel to the digital spectrum. This helps a station preserve its investment in channel branding because it allows DTV receivers to electronically associate the two channels. This allows the viewer, through the STB, to easily navigate between a station's current analog channel and its associated DTV channels or services.

Branding over cable

It goes without saying that maintaining channel branding over cable distribution is important for broadcasters. The existence of differing cable-channel lineups is causing concern among many broadcasters because it implies that cable will be tearing apart terrestrial multichannel ATSC streams and reassembling them based on the cable operator's agenda or channel plan. But the FCC considers PSIP information to be related to the primary digital video signal, and has ordered cable operators to pass this information through their systems. The NCTA and CEA agreed in February 2000 that cable operators will pass most PSIP tables (STT, MGT, VCT, and EIT-0 through EIT-3) when they appear in the stream (subject to fairly stringent bandwidth limits). But this set of tables doesn't include all the tables typically needed to build a robust program guide, since the NCTA exempted higher-level Event Information Tables (EITs) or Extended Text Tables (ETTs) from the agreement. Of course, broadcasters would like cable companies to allow all the PSIP tables in the broadcast stream to pass through, so they must sort out obvious issues with cable companies. Finally, if the FCC orders cable operators to carry all digital video channels broadcast to the general public, it stands to reason that it will require cable operators to pass channel-mapping PSIP information for these channels as well.

Program-specific information

A second service that PSIP brings to DTV is program-specific information for viewers as they scroll through the EPG (see Figure 2 on page 84). At least four EITs and associated ETTs provide these program-information data. The EITs, which are associated to a specific virtual channel in the VCT, contain TV program (event) information such as event ID, start time, duration (in seconds) and event titles, and point to the location of extended text in the ETT. As previously noted, the EIT also supports associated metadata such as closed-caption, content-advisory, broadcast-flag and AC-3 audio descriptors. The EIT allows the broadcaster to control the description of his

programming as he chooses.

The ETT is fundamentally responsible for providing broadcasters the ability to support extended program-description information in the EPG. The EIT carries the name of the program, while the ETTs carry longer text messages for describing events and virtual channels. Each EIT entry has a pointer to allow connection to the appropriate ETT, as does the VCT. In addition, the ETT can support descriptions in multiple languages. To reduce bandwidth, text strings in the ETT may use Huffman coding. The MGT defines sizes, PIDs and version numbers for all of the EITs and associated ETTs.

There can be as many as 128 EITs. Each table describes the events for a three-hour interval. Thus, the station can send as many as 16 days of programming in advance. At minimum, every transport stream must include the first four EITs, and the station should include at least 24 EITs (about three days' worth). As mentioned earlier, the cable operators have only ensured that they will pass four EITs. Each EIT representing a time slot can have multiple instances — one for each virtual channel.

Enhanced services

Finally, let's take a quick look at the remaining PSIP tables: the Data Event Table (DET), Directed Channel Change Table (DCCT) and DCC Selected Code Change Table (DCCSDT). Currently, these tables are not in wide use, but stations will likely make more use of them as the ATSC market matures.

The DET announces the data portion of a video/audio/data event when the data event doesn't exactly match the video/audio event in duration (in which case, the EIT carries information about the data). This is an important factor in datacasting applications and advanced STB applications. Essentially, the DET allows the station to announce data-enhanced services. This allows a viewer looking at the program guide to see which DTV program streams carry enhanced data such as statistics for sports programming or Web-page content to supplement the audio and video streams. Additionally, PSIP can announce the existence of stand-alone data, either related to programming or totally divorced from it, such as computer software or media files like AVI files. In the future, it is quite possible that broadcasters, instead of transmitting many real-time program streams, will send some combination of real-time and non-real-time files. The STB could then stream out the multimedia files at the viewer's request.

The DCCT instructs the receiver to change channels based on viewer preferences, demographics or geographical location. This table from the broadcaster works in conjunction with a DCCSDT in the STB. The table defines the classification scheme that viewers use to express preferences during receiver setup. This feature could become important if HD channels are brought up while SD channels are temporarily dropped.

Doing it right

Correct implementation of PSIP is essential. Some broadcasters have already found that incorrect implementation of PSIP can render some or all of their NTSC and DTV services unavailable to DTV receivers. In ATSC's infancy, the mis-programming of PSIP data allowed DTV stations to "hijack" other DTV stations' virtual channels inadvertently through the STB. PSIP has been designed to allow broadcasters to take advantage of new digital-transmission capabilities. Along those lines, an interesting ability of PSIP is to tie the virtual channels of separate physical DTV channels together. In the DTV realm, duopolies will be able to combine the two stations seamlessly under a single brand.

Reducing static

PSIP, although not currently explicitly required by the FCC, is an ATSC requirement. Many DTV stations to date still use only static PSIP produced by the encoder/mux. At this most simple operational level, the station manually enters the VCT and MGT tables, along with four (generally blank) EIT tables, into the ATSC mux (the mux must dynamically generate the STT). This minimum implementation does not support audio language selection, closed-caption selection, broadcast flag, V-chip or program guide. The broadcaster also gives up PSIP's promotional capabilities.

If STBs are ever to build worthwhile electronic program guides, then broadcasters will have to fill all the aforementioned tables and do so at an ever-changing rate. Dynamic PSIP requires a separate subsystem — either a separate stand-alone box or modules added to a vendor's mux that accept a constantly updated datastream — to continually update the PSIP tables. Updated tables are available from companies such as Tribune Media Services, Scout, or organizations such as the PBS National Database (NOLA), and from traffic and even automation systems. A station can generate dynamic PSIP without human intervention by taking advantage of information updates from systems they already use (see Figure 3).

Some PSIP generators can even synchronize with encoder/mux configurations, dramatically easing transitions from a single HD virtual channel to/from multiple SD virtual channels. Static PSIP will certainly have become dynamic before the FCC decides to clamp down on ATSC broadcasts in the areas of closed captioning and the broadcast flag so widely discussed today. It is known as the redistribution-control descriptor, and the broadcast flag's purpose is to signal to the STB whether or not it should allow the viewer to record a particular program. Dynamic PSIP indicates the presence of closed captioning and the broadcast flag.

In static PSIP environments, closed-caption data are often flagged as available. The problem with marking every program as having captioning service available, whether or not it is actually available, is that some STBs have been known to crash occasionally and require resetting. As for the redistribution-control descriptor, it will need to be set on a show-by-show basis based on contractual agreements.

By the time NTSC is currently scheduled to go dark, 100 percent of all new non-exempt programming must have closed captioning. And, by 2008, 75 percent of pre-rule programming must also have closed captioning. There are several exemptions, including programs created before 1996 that do not have contractual obligation to provide closed captioning, any program whose provider can convince the FCC that captioning presents too great a burden, programming done in any language other than English or Spanish, programs having lengths of less than 10 minutes, and local programs that have no repeat broadcast value. Other exemptions include startup broadcasters (with a four-year grace period) and extremely small broadcasters. In all, the commission has 13 items that can exempt captioning. But, for the average broadcaster, most will never apply. Since many STBs require the presence of the closed-caption descriptor in PSIP to decode the closed-caption data, using dynamic PSIP is the only way to completely comply with the FCC's mandates for end-to-end closed captioning.

Implement PSIP now

As the ATSC market continues to mature now and in the future, one thing is sure: Competitive and legislative pressures will affect how broadcasters continue to support PSIP. Be prepared. It is in a station's best interest to adopt dynamic PSIP. Alternative systems that take away the broadcaster's control of branding and promotion are showing up in the marketplace.

As the old saying goes: "Use it or lose it."

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