

## Agenda

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- ✓ *ATV Review*
  - ✓ *DTV Overview*
  - ✓ *Transport Basics*
  - ✓ *Television Stuff – A & V*
  - **Metadata – PSI & PSIP**
    - Amateur DTV
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## Metadata

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- Data about included data is metadata
  - Metadata tells the decoder which kinds of information are contained in each PID, and which PID's go together.
  - There are two kinds of Metadata
    - **Program Specific Information (PSI)** - Tables in the stream defined in the MPEG standards
    - **Program and System Information Protocol (PSIP)** - Tables defined in ATSC A/65
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## Signaling vs Announcement

- Signaling
  - Information about what is "on now"
  - Used to assemble program elements into whole
    - Provides linkages
    - Ex: PMT and/or VCT used to link different components of television program (I.e. video and audio)
  - Used to define characteristics of current program
    - Captioning, ratings, redistribution...
- Announcement
  - Information about what will be available in the future
  - Program Guide information (name, description schedule)
  - Characteristics of future programs (captioning, ratings, redistribution...)
  - Typically does not provide linkages between program elements

## MPEG-2 Program Specific Information (PSI)

- Gives very basic tuning information:
  - PAT (Program Association Table): one for entire transport stream; identifies "programs" (virtual channels) in stream and gives PIDs for PMTs.
  - PMT (Program Map Table): one per "program"; identifies elementary streams in "program" and gives their types (audio, video, etc.) and PIDs.
- Supports tuning by physical channel number and MPEG-2 program number.

## Graphical View of PAT/PMT

Triveni StreamScope - File D:\Streams\KQZK\JAFTER.tp, Vi

Video View VSB View

Details Window

PAT:

- SectionArray:
  - transport\_stream\_ID: 0x0663
- ProgramArray:
  - ProgramNumber:
    - program\_number: 0x0002
    - program\_map\_PID: 0x0020
  - ProgramNumber:
    - network\_PID: 0xFFFFFFFF

(PID 0x0000)

Triveni StreamScope - File D:\Streams\KQZK\JAFTER.tp, Vi

Video View VSB View

Details Window

PMT:

- SectionArray:
  - program\_number: 0x0002
  - PCR\_PID: 0x0021
  - program\_info\_length: 22
- DescriptorArray:
- ElementaryStreamArray:
  - ElementaryStream: (stream\_type) 0x0002, Video
  - ElementaryStream: (stream\_type) 0x0081, AC3 Audio

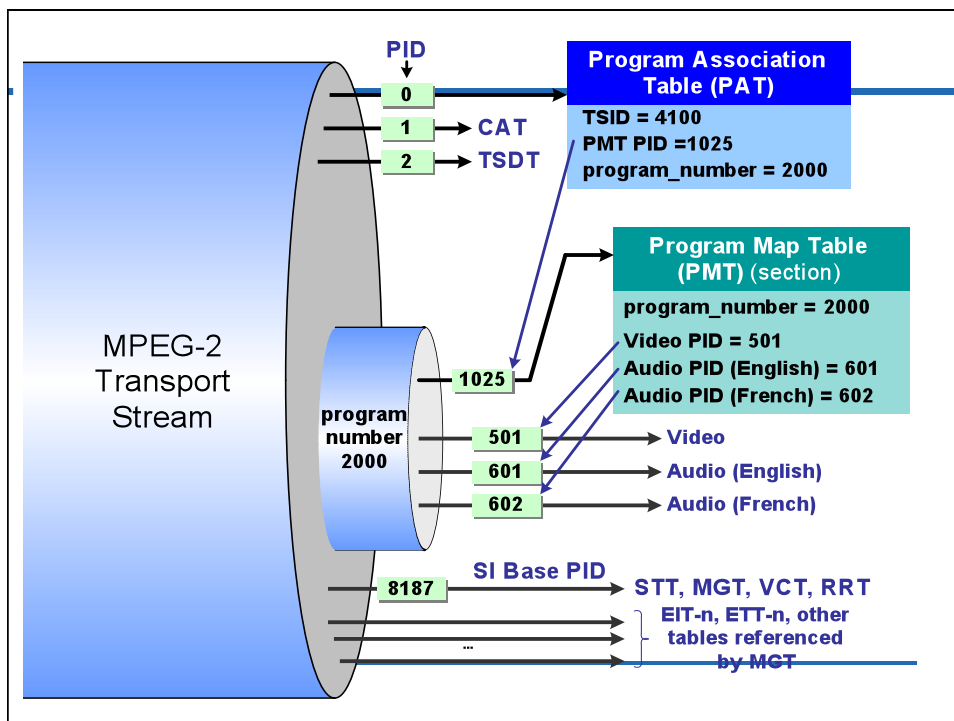
Triveni StreamScope - File D:\Streams\KQZK\JAFTER.tp, Vi

Video View VSB View

Details Window

PMT:

- SectionArray:
  - program\_number: 0x0003
  - PCR\_PID: 0x0031
  - program\_info\_length: 24
- DescriptorArray:
- ElementaryStreamArray:
  - ElementaryStream: (stream\_type) 0x0002, Video
  - ElementaryStream: (stream\_type) 0x0081, AC3 Audio



## PSIP Background

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- Program and System Information Protocol
  - Metadata inserted into broadcast stream
  - Enables:
    - Tuning to virtual channels
    - Displaying channel name (on channel changes)
    - Interactive electronic program guides (EPGs)
    - Automatic language selection for audio track
    - Caption decoding
    - "V-Chip" function (parental content blocking)
    - Accurate receiver time-of-day clock setting
    - Redistribution Control
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## PSIP from the User's Viewpoint

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- "Where am I?"
    - Channel number, channel name
  - "Where am I going?"
    - Channels organized by major/minor groups
    - Enables EPG in the receiver/STB
      - What's on now?
      - What programs do I want to plan to watch?
  - "How can I get where I want to go?"
    - Direct entry of channel number
    - Navigation on the EPG grid
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## Virtual Channel Concept

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- Breaks the link between RF channel number and user's notion of channel number
    - Analog broadcast → "channel number" was the same as the RF carrier designation
    - Digital broadcast → "channel number" is defined by Virtual Channel Table (VCT)
  - One digital TS can include multiple channels of programming
  - 8-VSB carrier freq. may shift during transitions
- 

## Two-Part Channel Numbers

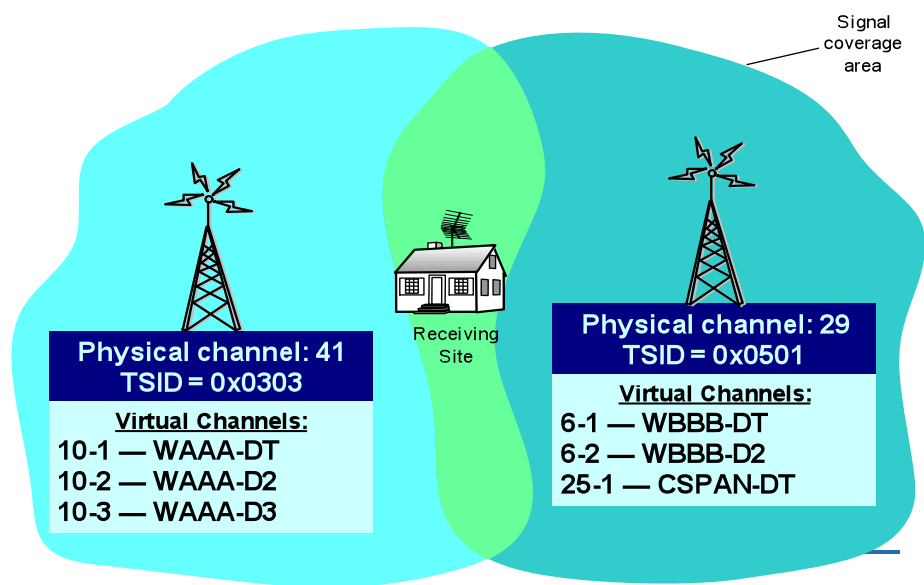
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- 1<sup>st</sup> part: "major channel"
  - 2<sup>nd</sup> part: "minor channel"
  - Broadcasters retain their brand identity
    - Digital services groupable with analog
      - Will become irrelevant soon
    - KZZZ has been associated with Channel 7 for years; KZZZ-DT can be found on Channel 7-1
-

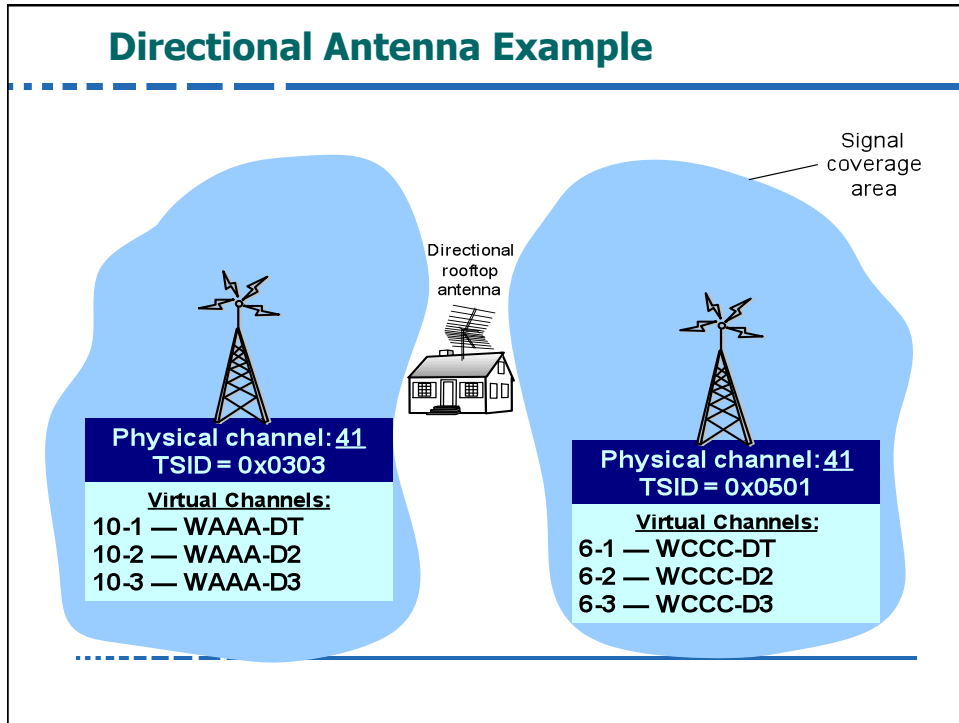
## Transport Stream ID (TSID)

- Assigned to be unique
- Managed by FCC
- DTV tuning by triplet
  - RF frequency
  - Major channel number
  - TSID
- Receivers may find duplication of RF freq and/or major channel number
  - RF/Channel #/TSID always unique

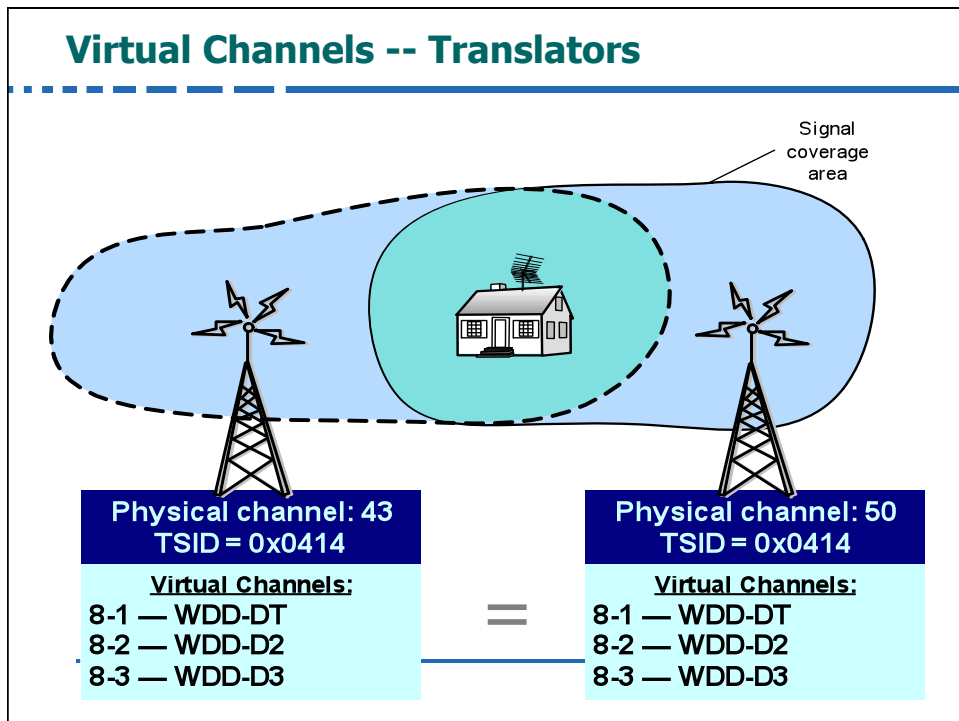
## Simple Reception of 2 Stations



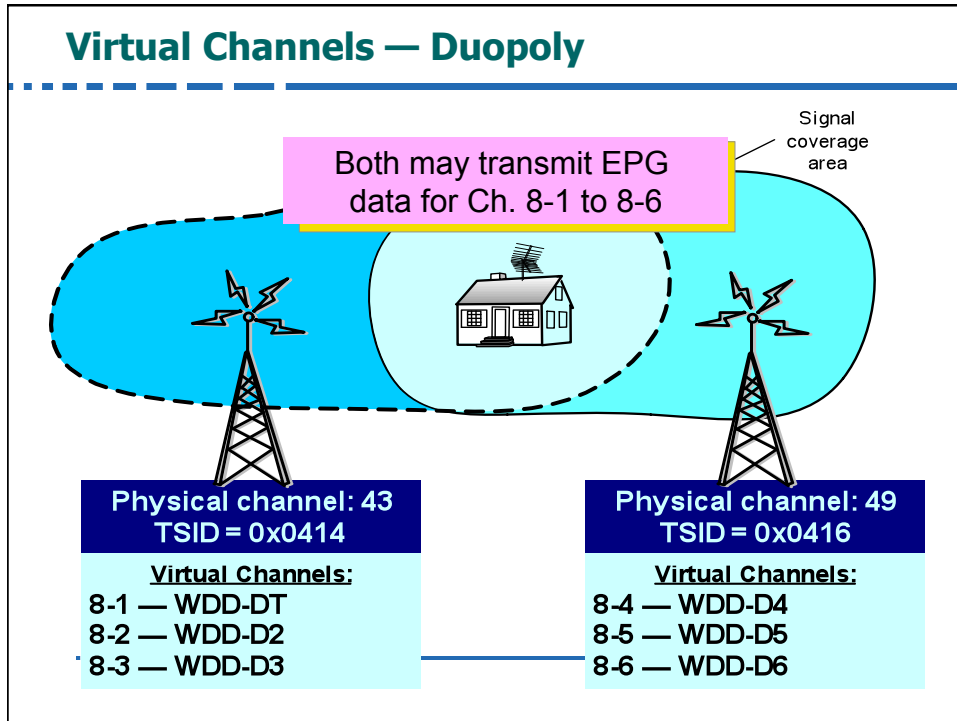
## Directional Antenna Example



## Virtual Channels -- Translators



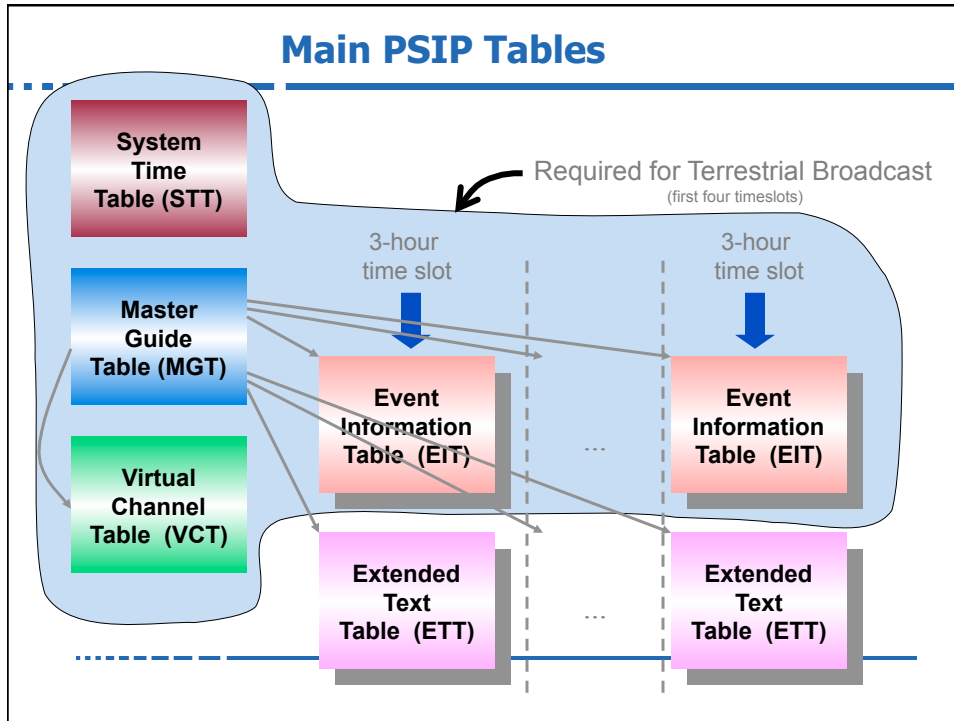
## Virtual Channels — Duopoly



## ATSC PSIP Tables

- Master Guide Table (MGT)
  - Directory of all PSIP tables (signaling)
- System Time Table (STT)
  - What time is it? (signaling)
- Virtual Channel Table (VCT)
  - List of the virtual channels in the transport (signaling)
- Rating Region Table (RRT)
  - Ratings definitions for the region (signaling)
- Event Information Table (EIT)
  - Event scheduling (announcement - used for EPG)
- Extended Text Table (ETT)
  - Event descriptions (announcement – used for EPG)





## Master Guide Table (MGT)

- MGT is the top-level “roadmap”
  - Identifies what PSIP tables are in transport stream
  - Gives PIDs so receiver can find them
  - Indicates when any table has been updated

The screenshot shows the Triventi StreamScope interface. The 'Details Window' displays the following information for the MGT:

```

MGT:
  SectionArray:
  protocol_version: 0x0
  tables_defined: 51
  TableDefinitionArray:
    TableDefinition: (table_type): Terrestrial VCT
    TableDefinition: (table_type): 0x0200, ETT 0
    TableDefinition: (table_type): 0x0201, ETT 1
    TableDefinition: (table_type): 0x0202, ETT 2
    TableDefinition: (table_type): 0x0203, ETT 3
    TableDefinition: (table_type): 0x0204, ETT 4
    TableDefinition: (table_type): 0x0205, ETT 5
  
```

A red box highlights the 'TableDefinitionArray' section, with a red arrow pointing to a callout box titled 'Table Reference'. The callout box contains the following list:

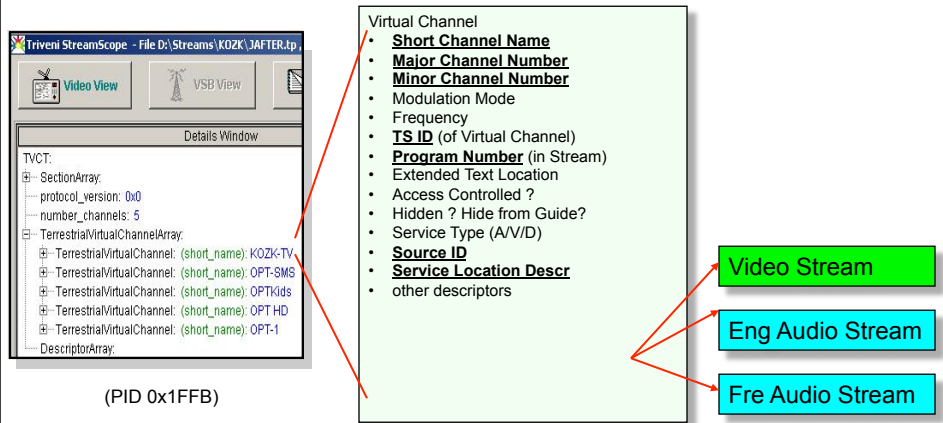
- Table Type (VCT, EIT-0, etc.)
- PID where table can be found
- Referenced Table Version
- Referenced Table Size
- <descriptors>

Below the screenshot, the text '(PID 0x1FFB)' is displayed.

## Virtual Channel Table (VCT)

- Has same info as PAT & PMTs, plus more.
- Allows tuning by virtual major-minor channel number, rather than physical channel number and MPEG-2 “program” number.
- Allows language track selection.
- Allows channel name to be displayed on channel changes and in EPG.
- ATSC receivers are designed to use VCT; may have trouble with PAT and PMTs alone.

## Virtual Channel Table (VCT)



## Event Information Tables (EITs)

- Describe "events" (TV programs).
- EIT-0 through EIT-127; each covers 3 hour period
- EIT-0 thru EIT-3 required. ▶

**VCT**

VC 1

VC 2

Triveni StreamScope - File D:\Streams\K0ZK\JAFTER.tp, Video P

Video View VSB View Sumr

Details Window

```

EIT:
- SectionArray:
  - source_id: 0x0003
  - protocol_version: 0x0
  - num_events_in_section: 7
- EventArray:
  - Event (title): Anne of Green Gables: The Animated Series
  - Event (title): Adventures from the Book of Virtues
  - Event (title): OPTKids will resume at 6 A.M.
  - Event (title): Zoom
  - Event (title): Caillou
  - Event (title): Clifford The Big Red Dog
            
```

**Event**

- Event ID
- Start Time (GPS)
- Duration in Seconds
- Title (multiple languages)
- Extended Text Location

**Descriptors**

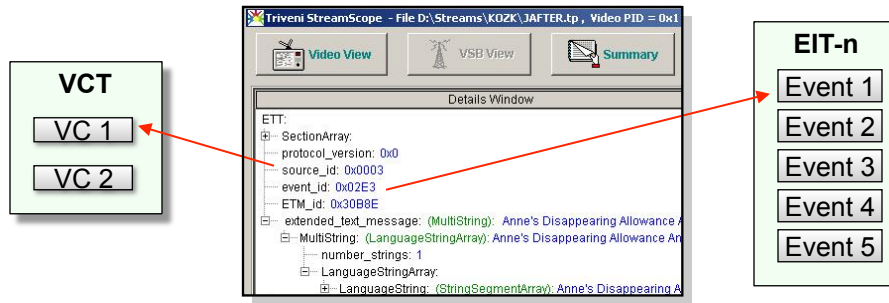
- Content Advisory
- Closed Captioning
- AC-3 Audio
- Broadcast Flag

## Electronic Program Guide (EPG)

Channel	6:30pm	7:00pm	7:30pm
KXYZ-DT (7-1)	Local News	Ben's Lab	Thunder Car
KXYZ-D2 (7-2)	Movie: "Frontier Brain Surgeon"		
KXYZ-D3 (7-3)	Movie: "Burnout" (5:00)	Gena	Horace Horse

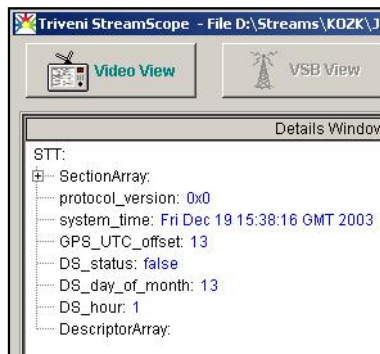
## Extended Text Tables (ETTs)

- ETT-0 thru ETT-127, plus a "channel ETT"
- Text descriptions for channels and events
- May use Huffman coding to reduce bandwidth
- May be in multiple languages



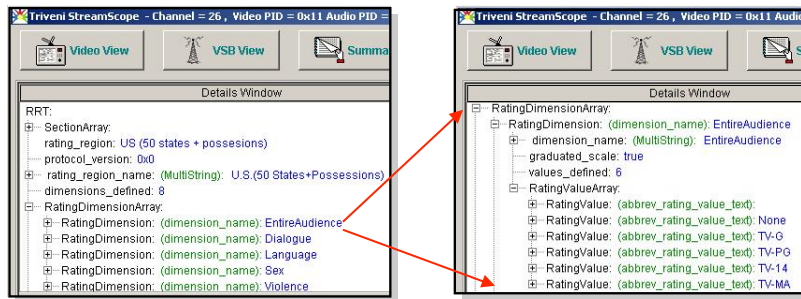
## System Time Table (STT)

- Clock Time
  - Current GPS time
  - Daylight savings time indicators



## Rating Region Table (RRT)

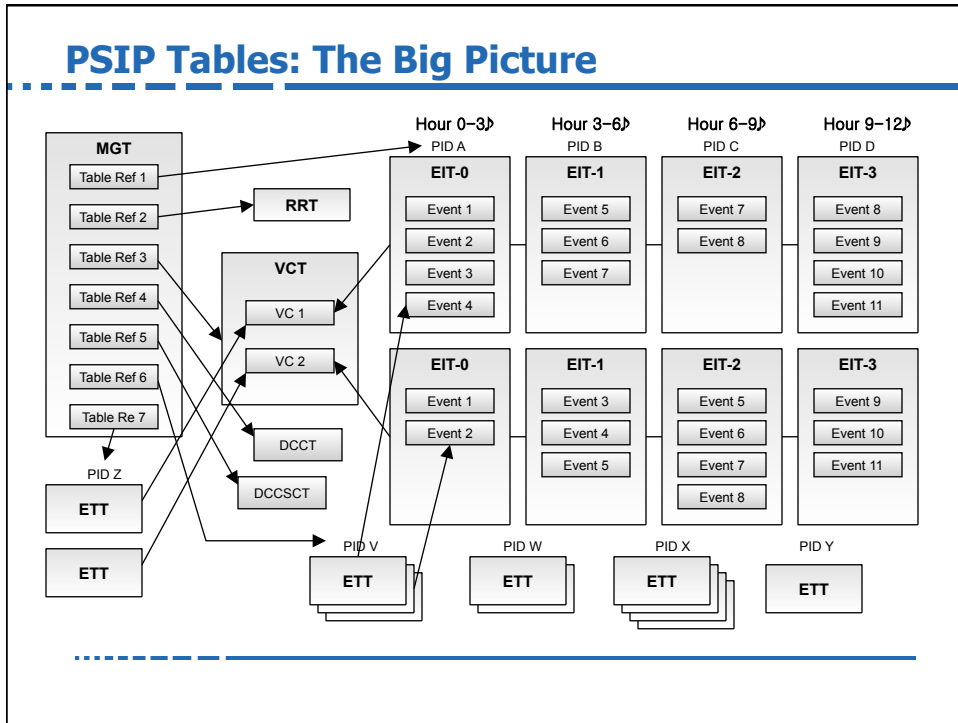
- Defines content advisory system(s) in use
  - Defines rating scheme(s) for rating region(s) (MPAA and TV Parental Guidelines in USA)
  - Ratings referenced by Content Advisory Descriptors in EITs



## PSIP Descriptors

- Descriptors are tag-length-data structures
- Descriptor tag must be a registered value
- Some ATSC-defined descriptors include:
  - Content Advisory
  - Caption Service
  - Redistribution Control
  - Audio Stream (AC-3)
  - ATSC Private Info
  - Extended Channel Name
  - Service Location
  - ATSC Conditional Access
  - Component Name

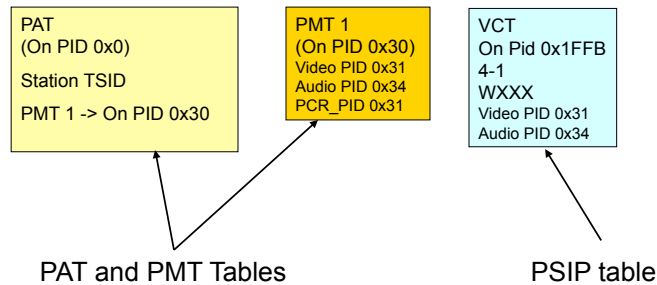
## PSIP Tables: The Big Picture



The screenshot shows a TV guide interface for the program **National Geographic Explorer** on **TBS** at **25.8**. The program is scheduled for **6:30 PM - 8:00 PM** on **Mon Jun 8**. The description reads: "Explorer meets dwellers in Canadian forest. Coyotes, deer, owls, and various small creatures." Callouts identify various PSIP tables: **STT** (Service Time Table) for the channel, **EIT** (Event Information Table) for the program, **ETT** (Event Table) for the program, **VCT** (Video Content Table) for the program, and **VCT** (Video Content Table) for the channel. The guide also shows other programs like **WCW Wrestling**, **Larry King Live**, **Tommy Boy**, **Crossfire**, **Highlander**, **The Jerk**, **The American...**, **Eat, Drink, ...**, **Titanic**, **Seinfeld**, **Ellen**, **Mad About You**, **The Jerk**, and **Home Improvement**, **One Fine Day**.

## PSIP and PSI Link

Table Information for a  
Television Broadcast Stream



## Table Intervals

- Metadata is transmitted periodically in the transport stream
- Each table in the system, MPEG or PSIP, has a defined repetition rate. e.g. the Program Association Table (PAT) must appear in the transport stream every 100ms
- If the table does not appear frequently enough in the stream, it can cause minor problems while decoding
- If the table is MISSING all together then larger decoding problems begin to occur