Display Technology, VESA and EDID

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Joe Miseli
Sun Microsystems

joe.miseli@sun.com

Abstract

EDID (Extended Display Identification Data) Standard defines data formats to carry configuration information about display devices.

It became E-EDID (Enhanced Extended Display Identification Data) in 1999 when extension blocks were added. For this presentation, we will refer to EDID to mean E-EDID or EDID.

This is overview of display technologies and EDID with respect to display devices will be given. EDID is needed as the primary identification mechanism with regard to displays for computer systems and any device which sends information to displays since about 1996. Yet EDID is diverse, with multiple parts. It is changing rapidly and has many associated VESA standards. EDID 1.4 has just been introduced. A review of those standards will be presented.

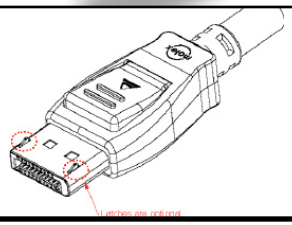
Display Technologies

- Primary Display Technologies in Use today
  - CRT's
  - LCD's
  - Plasmas
  - Projectors
    - Front Projectors, which fill a screen from a distant point
    - Rear Projectors, which are in self-contained enclosures
      - DLP (Digital Light Projects), based on TI's DMM technology
      - LCOS (Liquid-Crystal on Silicon)
      - AM-LCD (Amorphous Silicon LCD)
      - Poly-LCD (Polysilicon LCD)
  - All use EDID to communicate their resolution capability

Displays and Scalers

- Most fixed-pixel array displays have scalers
  - ➡ Convert incoming timings into the display's native timing
  - ➡ May have all of the EDID recommended base timings
- Newer and higher resolution displays have no pure scalers
  - ✦ e.g. 30-in LCD monitors at 2560x1600
    - ➡ Accept single resolutions, or direct divisions, such as 1280x800
  - ✦ Scalers tend to top out at 1920x1200
    - ➡ approximately the highest level of HDTV, or 1920x1080
  - ✦ EDID becomes critical for a graphics card to know how to drive such displays

Most Common Display Interfaces

Interface	Analog/ Digital	Connector	Date
VGA (D-Sub, HD-15)	Analog		1987
DVI-D	Digital		1999
DVI-I	Analog & Digital		1999
HDMI	Release A		2005
DisplayPort	Digital		2006

Timing and Resolution

- A display device might have many timings.
  - EDID will specify the primary and alternate timings of a display.
  - However, a display may have many timings, well beyond those which can be contained in the limited space of and EDID block.
    - Some displays, like CRT's have infinite timing variation capabilities.
    - Other displays, have PLL's to try to capture incoming signals which are not recognized to be known timings.
      - DVI-D is much better than analog, since it has a pixel clock
- Other displays have few timings, maybe only one
  - e.g. 30-in LCD with 2560x1600 resolution
    - No scaler to adapt alternate timings
      - Native resolution, or native resolution/2
    - All handled by EDID

Default Timing

- EDID has one dominant purpose:
  - To assure video is seen on a display either at turn-on or when hot-plugged (e.g. plug and play)
    - *Blanked-out displays for a running system mean **Trouble**!*
- The most common default timing is VGA
  - 640x480 typically, but can be a variant, like 720x400
  - Some systems have their own default timings
    - e.g. Sun Microsystems 1Megapixel default of 1152x900
      - With composite sync

Signals to a Display

- Components of a Video Signal
  - Video content
    - For digital video, has a clock which times it content as pixels
    - True analog video has no clock (or even pixels), which makes problems for flat panels
  - Blanking
  - Synchronization (sync)
- I^2C Digital Signals are used for communications via DDC between a host and display
- Other signals might be present in other interfaces
  - e.g. audio or control signals

About Timings

- What is timing (for displays)? *[Assume sequential scan]*
  - Timing is the rate at which the video signal is sent from a host to a display.
  - It is the temporal definition of the display signal which defines all of its characteristics to assure
- Components of timing
  - Resolution (e.g. 640x480, 1280x1024, 1920x1200)
    - This is the dominant characteristic which also defines the display capability
  - Vertical or refresh rate (e.g. 60Hz, 75Hz, 85Hz)
  - Horizontal rate (or line rate)
  - Blanking
  - Sync

About Timings, continued

- Where do timings come from?
  - Historically hand-calculated, such as follows (for progressive scan):
    - Horizontal time = (HPix + HblankPix) / PixClk = 1 line
      - e.g. (1280 + 408) / 108.0MHz = 15.630µs
    - Vertical time = Htime * (Vpix + VblankPix) = 1 frame
      - e.g. 15.630µs * (1024 + 42) = 16.667ms = 1/60Hz
- Where can you find out about timings?
  - VESA standards
    - DMT (Display Monitor Timing) - pages of detailed timings
    - CVT (Coordinated Video Timings) Standard & Spreadsheet
    - GTF (Generalized Timing Formula) now replaced by CVT
- How to generate new timings or timings “on the fly”
  - CVT, now incorporated into EDID & Hosts

Synchronization

- Synchronization can often make problems if not understood
- Three main sync types
  1. Separate sync
     - Can have either positive or negative for either H or V
     - Requires two signal paths, one for H and one for V
  2. Composite sync
     - H and V are combined in a single phase-coherent signal
     - Not “officially supported” for digital (DVI) but works,
       - As long as the monitor can handle it
     - Must be phase-coherent - Do not confuse this with X-Or-ing! (or X.org)
  3. Sync on green (SOG)
     - H and V combined as like “Composite Sync” but are added with a DC shift as part of the Green signal
       - Analog only - Does not work for digital (DVI)

What is EDID & why is EDID important

- What is EDID?
  - EDID is 128 bytes of encoded data stored in a display or other interface device
  - It can contain extension blocks of 128 bytes or more
- Why is EDID important?
  - EDID is the basis for “Plug & Play” for all Display/Graphics sub-systems.
    - Without this feature, a graphics system and a monitor cannot be assured of working together, and may not display video sent to it.
    - *Blanked-out displays for a running system mean **Trouble**!*

Base EDID History

Standard	Version/ Release	Revision	Base EDID Structure	Date
EDID 1.1	V2	0	V1 R0	Apr 9, 1996
EDID 1.2	V3	---	V1 R1	Nov 13, 1997
E-EDID 1.3	Release A	1	V1 R3	Feb 9, 2000
E-EDID 1.4	Release A	2	V1 R4	Sep 25, 2006

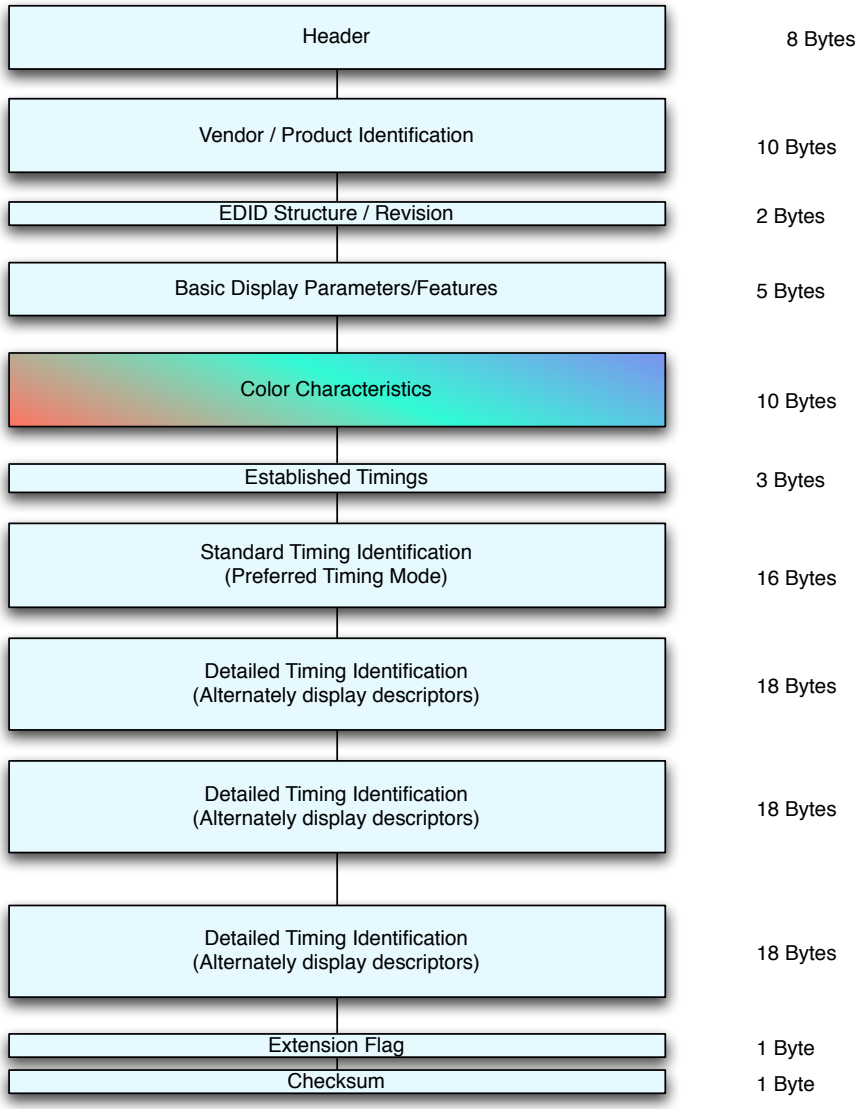
EDID History with Relevant Associated Standards

Standard	Version/ Release	Revision	Base EDID Structure	Date
DPMS	V1.0	1.0	---	Aug 20, 1993
DDC	V1.0	0	V1 R0	Aug 12, 1994
EDID 1.1	V2	0	V1 R0	Apr 9, 1996
EDID 1.2	V3	---	V1 R1	Nov 13, 1997
E-EDID 1.3	Release A	1	V1 R3	Feb 9, 2000
DPM	Release A	---	---	Mar 3, 2003
E-DDC		1.1		Mar 24, 2004
Plug & Play	Release A	---	---	Jun 7, 2004
E-EDID 1.4	Release A	2	V1 R4	Sep 25, 2006

VESA Top-Selling Standards FPDM
(Flat Panel Display Measurements Standard)

- Highest-selling standard in VESA is the FPDM
  - Flat Panel Display Measurement Standard
- Highest-usage standard in VESA is EDID
  - In use in nearly every monitor since 1996, with CRT's, LCD's, Plasmas, or any variant of projectors

EDID Diagram



EDID Timing Priority Order

Priority	Timing Modes Listing in Base EDID and Extensions Structure
1	“Preferred Timing Mode” as defined in Base EDID
2	Other ‘Detailed Timing Modes’ in the order listed in BASE EDID
3	Any additional ‘Detailed Timing Modes’ (priority is in the order listed) in optional EXTENSION Blocks to the BASE EDID
4	Any optional 3-Byte CVT Codes (defined in optional Display Descriptors) listed in BASE EDID or an optional Extension Block.
5	‘Standard Timings’ listed in BASE EDID and in optional EXTENSION Blocks.
6	Additional Timing Mode Information: Established Timings I, II & III, Default GTF, GTF Secondary Curve & CVT
7	BASE VIDEO MODE (Default is often VGA)

VESA Standards Relevant to EDID

- DDC (E-DDC) - Interface
- CVT & DMT - Timing
- DPM - Display Power Management
- Extension Blocks - Extra EDID information
- DDC/CI - Display Data Channel Command Interface
- DPVL - Digital Packet Video Link
- MCCS - Monitor Control Command Set
  - Set of commands used to control display settings for any communication protocol between host and display
- MDDI - Mobile Display Interface Standard

DDC / E-DDC (Enhanced Display Data Channel)

- Defines a communication channel between a display and a host system
  - Bi-directional communications using an I^2C bus
- Used to carry configuration information to plug and play by communicating to the EDID memory block
- Exists on all display interface types today
- DDC went to E-DDC to support E-EDID
- Carried on three pins – data, clock and ground

CVT / DMT

- CVT - Coordinated Video Timings
- DMT - Detailed Monitor Timings
- CVT is a standard for generating timings for displays
  - Has both reduced-blanking timings (efficient for flat panels) and longer-blanking timings for CRT's.
  - Has a spreadsheet tool for entering timing details
  - Replaces GTF (General Timing Forumla)
- DMT is a standard which lists detailed monitor timings
  - Established monitor timings
  - Some are according to CVT and some predate it.

DPM (Display Power Management)

- Display Power Management Standard
  - To define a common method for producing and recognizing low power states for displays
  - Uses video signal components to trigger power management states
  - Replaces DPMS
  - Usually decoded to DE (Display Enable) for DVI digital channels

Display Power Management Table

State	Horizontal	Vertical	Video	DPM Compliance	Power Consumption
On	Pulses	Pulses	Active	Mandatory	Normal
Off	No Pulses	No Pulses	None	Mandatory	Low
	Pulses	No Pulses			
	No Pulses	Pulses			

DPM, continued

- Display Power Management Standard
  - DPM Replaces DPMS
- **DPMS and DPM Definition Table**

DPMS State	DPM State	Industry Definition
On	On	On
Standby*	Off	Sleep
Suspend*	Off	Sleep
Off	Off	Off/ Deep Sleep/ Standby Power

* Not Commonly Used

EDID Structure Extension Tag Numbers

Tag Numbers	Extension Block Description
02h	CEA-EXT: CEA 861 Series Extension
10h	VTB-EXT: Video Timing Block Extension
40h	DI-EXT: Display Information Extension
50h	LS-EXT: Localized String Extension
60h	DPVL-EXT: Digital Packet Video Link Extension
F0h	Extension Block Map
FFh	Extensions defined by the display manufacturer

EDID Extensions

- CEA-861C
  - DTV profile for uncompressed high speed digital video
  - From CEA, not VESA
- VTB-EXT - Video Timing Block Extension
  - Expansion EDID block for additional detailed timings
- DI-EXT - Display Information Extension Block
  - Useful display information like pixel layout, links, color depth, audio suport, orientation, dithering, gamma details
- LS-EXT - Localized String Extensions
  - For user-friendly information (string tables) for any languages

DDC/CI

- DDC/CI - Display Data Channel Command Interface
  - An I^2C - based protocol which operates over the the DDC channel
    - Provides interactive bi-directional communications between a host and display
    - For control of any display technology or associated devices
    - Interfaces: VGA, DVI, HDMI, etc.
  - Dan have control over a network
  - Display technology independent
  - MCCS codes are recommended for standards communications protocols
- Applications
  - Remote adjustments of displays
    - Examples: Image, color, geometry, audio, windows, DPVL
  - Power control

DPVL – Digital Packet Video Link

- DPVL allows for packetized video
  - e.g. Only pixels which are update on a display have information transmitted on the video link
    - Graphics card transmits only a part of the image
  - Make for low bandwidth video interfaces for higher bandwidth displays
  - Overcomes bandwidth limits of interfaces
  - Allows for graphics cards normally incapable of transmitting high resolutions in real time to otherwise drive the displays.

MCCS

- MCCS - Monitor Control Command Set
  - Set of commands used to control display settings for any communication protocol between a host and display
  - Not only computers, but also DTV
  - Implemented via a bi-directional serial links
    - Examples: I^2C - DDC based (like DVI or HDMI) or USB
- Types of Control Functions
  - Remote adjustments of displays
    - Examples: Image, color, geometry, audio, windows, DPVL
  - Manufacturer-specific controls

Brand New EDID – EDID 1.4

- Why was EDID 1.4 developed?
  - EDID 1.3 (first published on 9/02/99) is 7 years old.
  - EDID 1.3 does not support some newer VESA Standards.
  - EDID 1.3 is PC (IT) Centric --- no support for DTV products.
  - E-EDID Standard Rel. A, Rev. 1 (2/09/00) contains errors.
  - Examples in E-EDID Std. Rel. A, Rev.1 are obsolete.
  - EDID 1.4 addresses some of these issues.

What's new in EDID 1.4?

- Week & Year of Manufacturer or Model year
  - For EDID 1.3:
    - Week of Manufacture was optional
    - Year of Manufacture was required, but not stated in standard
  - For EDID 1.4:
    - Week of Manufacture remains optional
    - Year of Manufacture is required
      - May be defined as Year of Manufacture or Model Year
    - Stored Value = (Year of Manufacture {or Model year} - 1990)

Address	2 Bytes	Value	Description
10h	1	00h	Week of Manufacture is not specified
		01h - 36h	Week of Manufacture is specified (range is 1 -> 54 weeks)
		FFh	Model Year Flag ---Model Year is specified at address 11h
11h	1	10h - FFh	If Byte **10h** = FFh then Byte **11h** contains Model Year
		10h -> FFh	If Byte **10h** ≠ FFh then Byte **11h** contains Year of Manufacture

What's new in EDID 1.4? (continued)

- Video Input Definition
  - Video Input Definition expanded to include
    - Color Bit Depth Definition (Optional)
    - Digital Video Interface Standard Supported (optional)
      - e.g. DVI, HDMI, MDDI, DisplayPort
- H & V Screen Size and Aspect Ratio
  - H & V Screen Size can be defined as Aspect Ratio (add 15h, 16h)
    - Landscape vs. Portrait Orientation
- Feature Support Byte
  - Feature Support Byte (18h, Bits 4,3) may define
    - Display Color Type (analog inputs)
      - e.g. Monochrome, Grayscale, Undefined
    - Supported Color Encoding (digital inputs)
      - e.g. RGB 4:4:4, YCrCb 4:2:2, etc.

What's new in EDID 1.4? (continued)

- Feature Support Byte (continued)
  - Preferred Timing Mode (PTM) Bit 1 changed
    - Can include Native Pixel Format & Preferred Refresh Rates
  - Generalized Timing Formula (GTF) Bit 0 changed
    - For continuous frequency vs. multi-mode
- Detailed Timing Descriptor (18 Bytes)
  - Now supports Image Size or Aspect Ratio
    - Preferred Timing Mode is the native pixel format with optimal timing.
  - Display Product Name Descriptor is not optional but recommended
  - Display Range Limits Descriptor (formally Monitor Range Limits) is now optional.
  - Display Color Management (DCM) is now used
  - Included CVT (Coordinated Video Timing)
  - Increased Range Limits
    - Max vertical rate goes from 255Hz to 510Hz
    - Max horizontal rate goes from 255kHz to 510kHz
  - Updated EDID Extension Block Tags

EDID 1.4 Summary

- EDID 1.4 (E-EDID Release A, Revision 2) is the result of a 2-year effort to revise the E-EDID 1.3 Standard
- Was designed to support both monitors, DTV, and combined products
- Proper use of EDID 1.4 will support Plug & Play
- VESA Recommendations:
  - Source professionals: Begin developing graphics drivers and/or programs capable of decoding both EDID 1.4 and EDID 1.3 data structures
  - Display professionals: Begin adding EDID 1.4 data tables to the displays

Next Generation – Display ID

- .....and then there's Display ID

  - .....but that's another story.

End of Presentation

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