

An Introduction To TMDS

Understanding DVI-D, HDMI And DisplayPort Signals

“For a list of all the ways technology has failed to improve the quality of life, please press three.” — Alice Kahn



In This Presentation We Will Explore...

The Nature of TMDS – What Is It?
TMDS Applied
Digital Rights Management
TMDS, Audio And Control
TMDS Signal Installation Limitations And
Considerations



Why TMDS?

“DVI is the accepted standard for transferring serially uncompressed digital data at high speeds between a PC host and a digital display, such as an LCD monitor. DVI enables a video signal to be transferred from a PC source to a digital display in its native digital form, simplifying the way PCs communicate with displays and improving display image quality.”

— Digital Visual Interface And TMDS Extensions White Paper By Silicon Image (Oct. 2004)

- TMDS Transport Leverages The Native Digital Environment Of Fixed Pixel Displays Such As LCD Panels
 - Eliminates Complex A/D and D/A Conversions
- TMDS Is The Only Solution That Supports Very High Resolutions, Such As 9.2 Megapixel (3840 x 2400) Displays
- TMDS Supports Native 16 Million True-Color Resolution
 - 8 Bits (Plus 2) Allow 256 Color Shades Per Red, Green and Blue
 - New Extended Gamut Color (xvYCC) And Deep Color Can Push This To More Than 1 Billion Colors With 10 Bit Implementation (1024 Color Shades Per RGB)



What Is TMDS?



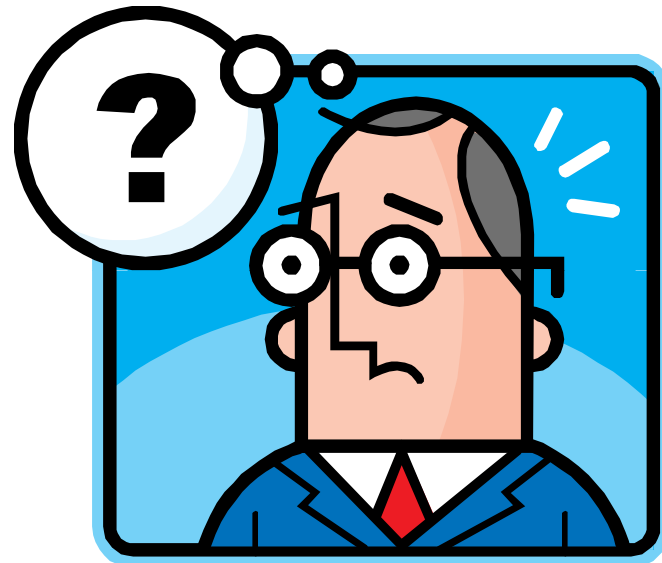
Transition Minimized Differential Signalling

- Developed By Silicon Image Inc. As A Member Of The Digital Display Working Group
- TMDS Is A Technology For Transmitting High-Speed Serial Data
 - Transmitter Incorporates An Advanced Coding Algorithm Which Reduces Electromagnetic Interference Over Copper Cables And Enables Robust Clock Recovery At The Receiver To Achieve High Skew Tolerance
- TMDS Uses 4 Channels: Red, Green, Blue, Clock
- TMDS Is A Two-stage Process Converts An Input Of 8 Bits Into A 10 Bit Code
 - TMDS Signalling Uses A Twisted Pair For Noise Reduction
 - Current Mode Logic (CML), DC Coupled And Terminated To 3.3 Volts.
 - 3 Twisted Pairs Are Used To Transfer Video Data - Each A Different RGB Component
 - 8-bit Data Transmission Plus 2 Bits Of Control Signals During Screen



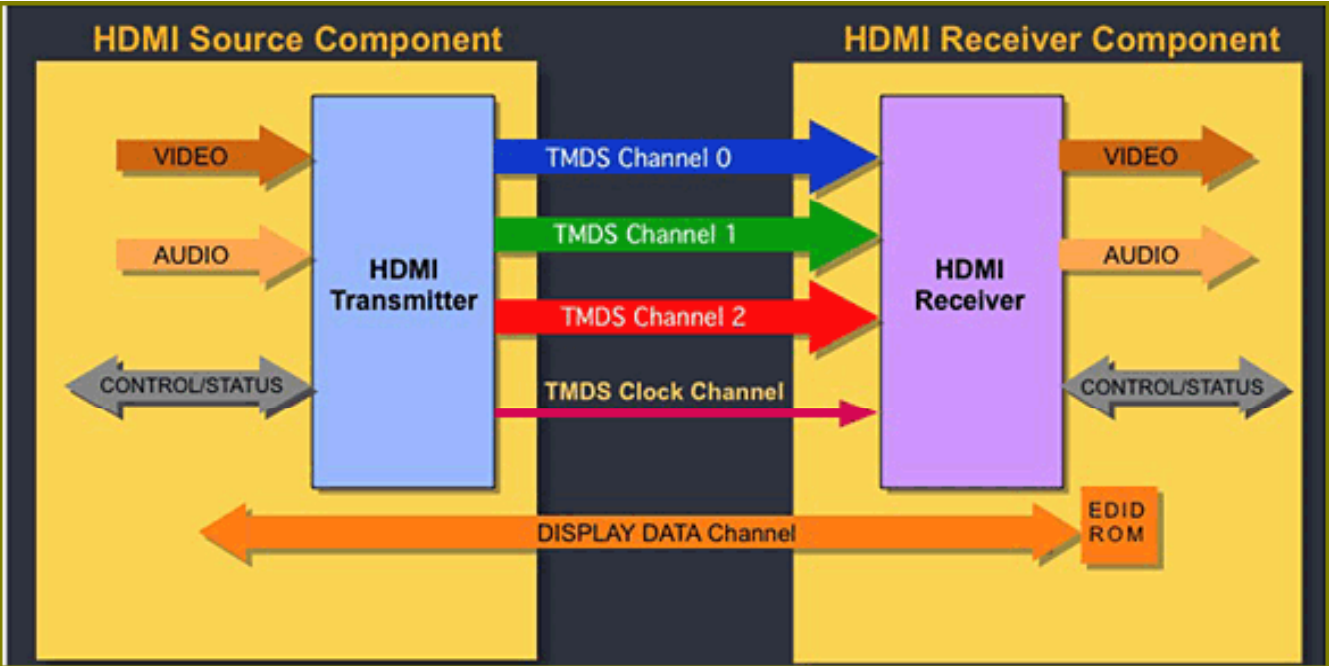
What Is Transmission Minimization?

- Doesn't 8- To 10-bit Transition Actually Increase Data Rates?
 - Algorithm Creates A Special 10-bit Sequence That Minimizes The 0-to-1 Transitions, Reducing RF Emissions
 - 8-bit Non-Encoded Requires 7 Transitions
 - TM Algorithm Reduces This To 3
- Active DC-Balancing Minimizes Voltage Swings
- Transmits Over Two Wires, Providing All The Benefits Of Balanced Connectivity
 - Common Mode Noise Rejection



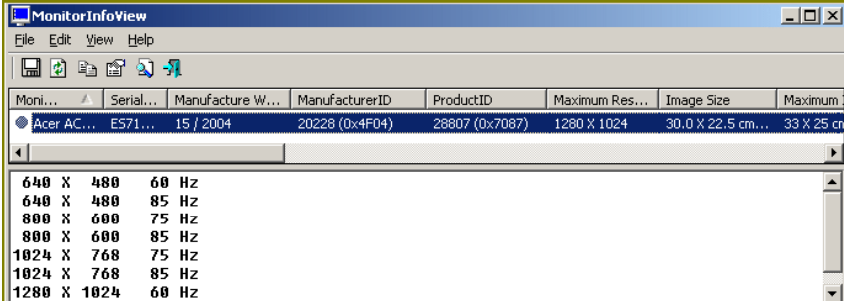
Hardware Communication





EDID and DDC

- Display Data Channel
 - Digital Communication Protocols Between A Display And Source That Allows The Display To Communicate Supported Display Modes And Adjust Parameters Such As Brightness And Contrast From The Computer Host



The screenshot shows the MonitorInfoView application window. The title bar reads "MonitorInfoView". The menu bar includes "File", "Edit", "View", and "Help". Below the menu bar is a toolbar with several icons. The main area contains a table with the following columns: "Moni...", "Serial...", "Manufacture W...", "ManufacturerID", "ProductID", "Maximum Res...", "Image Size", and "Maximum...". The first row of data is highlighted in blue and contains: "Acer AC...", "E571...", "15 / 2004", "20228 (0x4F04)", "26807 (0x7087)", "1280 X 1024", "30.0 X 22.5 cm...", and "33 X 25 cm...". Below this table is a scrollable list of supported display modes:

Resolution	Refresh Rate
640 X 480	60 Hz
640 X 480	85 Hz
800 X 600	75 Hz
800 X 600	85 Hz
1024 X 768	75 Hz
1024 X 768	85 Hz
1280 X 1024	60 Hz

- Extended Display Identification Data
 - Data Structure Provided DVI And VGA Displays To Describe Capabilities To A Graphics Card
 - 256-byte EDID Structure V1.3 Provides Monitor Name, ID, Model, Serial Number, Display Size, Aspect Ratio, Horizontal Scanning Frequency Limits, Vertical Frequency Limits, Maximum Resolution, Gamma And Supported Video Resolutions
 - EDID Data Set Is Far More Extensive For HDMI. In Addition To Video Resolutions And Aspect Ratios, It Carries Information About Supported Audio Formats, Data Rates, Bit Depths, Color Space Types, Data Block Types, And More...



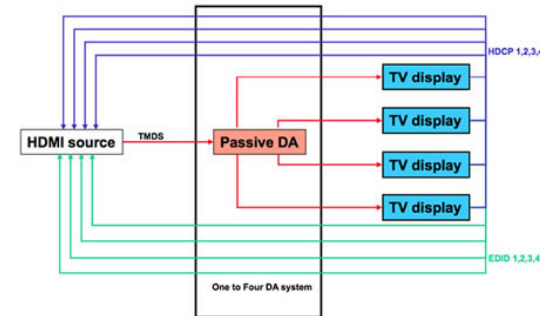
Digital Rights Management

“Obviously crime pays, or there'd be no crime.”
— G. Gordon Liddy

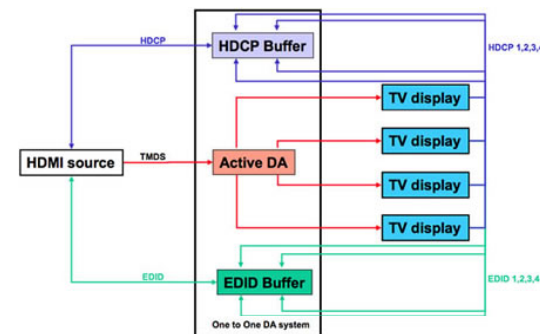


HDCP

- High-Bandwidth Digital Content Protection Prevents The Copying Of Digital Video And Audio Content
 - Utilizes Blom's Scheme, A Symmetric Threshold Key Exchange Protocol In Cryptography
- One Source Connected To One Display, HDCP Authentication (Key Exchange And Validation)
 - HDMI Protocol Allows For A Single Source To Authenticate More Than One Display
 - “One To Many” HDMI Application Is Not Well Supported



One to Four DA system. HDMI source is overwhelmed..



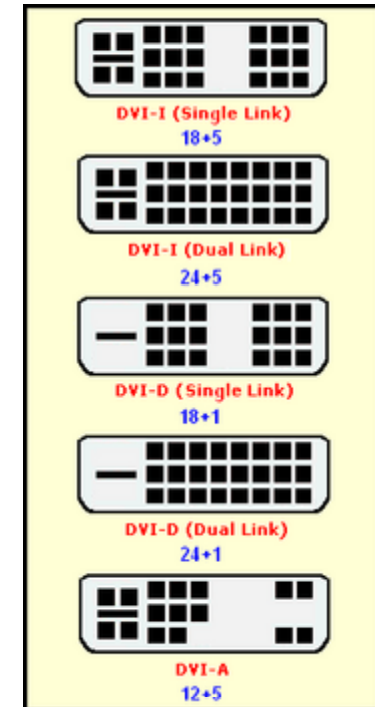
One to One DA system. HDMI source is normal..

TMDS Applied- Digital Visual Interface



Digital Video Interface

- DVI-A Is Analog
- DVI-I Integrates Analog And Digital
- DVI-D Is Digital
 - DVI-D Dual Link Is Two DVI-D Single Links In One Assembly
 - Supports Higher Resolutions And Higher Refresh Rates



DVI-D

- Robust, Locking Connector
- Single Link Screen Resolution At 60 Hz
 - WUXGA 1920 X 1200
 - HDTV 1920 X 1080
 - WXGA+ 1440 X 900
- Dual Link Screen Resolution
 - WQXGA 2560 × 1600 @ 60 Hz
 - QXGA 2048 × 1536)@ 75
 - WUXGA 1920 x 1200 @ 120 Hz



The High Definition “Mystical” Interconnect - HDMI



HDMI

- High Definition Multimedia Interface
 - Developed To Address The CE Market
 - Backwards Compatible With DVI-D
- Delivers Uncompressed Digital Video, Multi-Channel Audio And CE Control
 - Now At Level 1.3(b)
 - 1.4 Specification Adds Data Channel, Audio Return Channel, Higher Resolutions And 3D



Bicsi[®]

HDMI Adds CE Control and Audio

- CEC Is A One-wire Bi-Directional Serial Bus That Uses AV Link Protocol To Perform Remote Control Functions
- HDMI Supports Up To 8 Channels Of Uncompressed Audio
 - Up To 24-bit Word Length
 - Up To 192 KHz Sampling Rate
- HDMI Now Supports Additional Unique High Definition Audio Algorithms
 - Dolby TrueHD
 - DTS-HD



What HDMI CEC Is Supposed To Do...

Press Play on DVD



And then...
Plays DVD

Automatically...
Turns on A/V Rcvr



Automatically...
Switches to correct input
(from DVD player)

Automatically...
Turns on TV



Automatically...
Switches to correct input
(from A/V Receiver)

Adding Complexity For The Next Generation

An Overview of HDMI 1.4



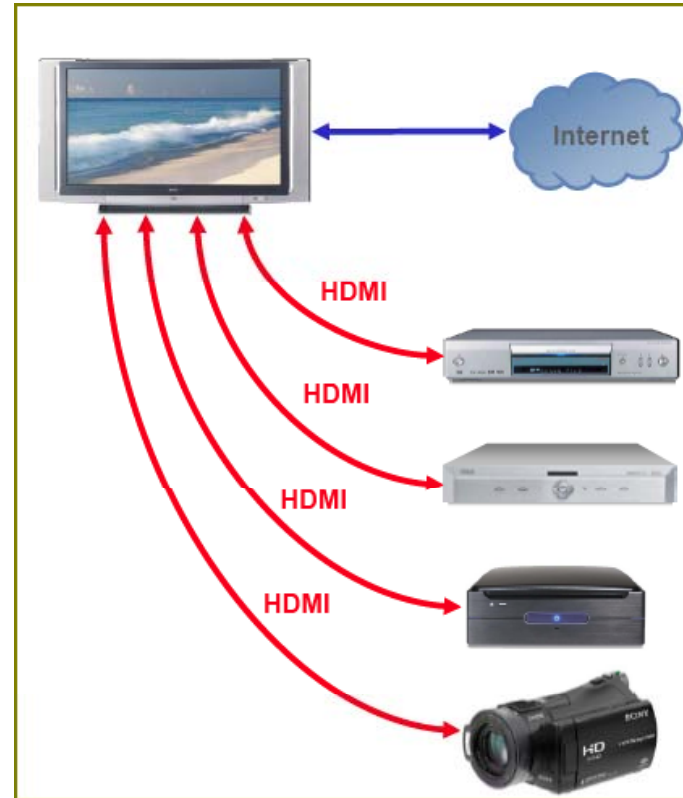
HDMI 1.4

- **HDMI Ethernet Channel** The HDMI 1.4 specification adds a data channel to the HDMI connection, enabling high-speed, bi-directional communication. Connected devices that include this feature can send and receive data via 100 Mb/sec Ethernet, making them instantly ready for any IP-based application. The HDMI Ethernet Channel allows internet-enabled HDMI devices to share an internet connection via the HDMI link, with no need for a separate Ethernet cable. It also provides the connection platform that will allow HDMI-enabled components to share content between devices.
- **Audio Return Channel** The new specification adds an audio channel that will reduce the number of cables required to deliver audio “upstream” from a TV to an A/V receiver for processing and playback. In cases where a TV features an internal content source, such as a built-in tuner or DVD player, the Audio Return Channel allows the TV to send audio data upstream to the A/V receiver via the HDMI cable, eliminating the need for an extra cable.
- **3D** The 1.4 version of the specification defines common 3D formats and resolutions for HDMI-enabled devices, enabling 3D gaming and other 3D video applications. The specification standardizes the input/output portion of the home 3D system, facilitating 3D resolutions up to dual-stream 1080p.
- **4K Resolution Support** The new specification enables HDMI devices to support extremely high HD resolutions, effectively four times the resolution of a 1080p device. Support for 4K allows the HDMI interface to transmit digital content at the same resolution as the state-of-the-art Digital Cinema systems used in many movie theaters.
- **Expanded Support For Color Spaces**
- **HDMI Micro Connector (Type D)**



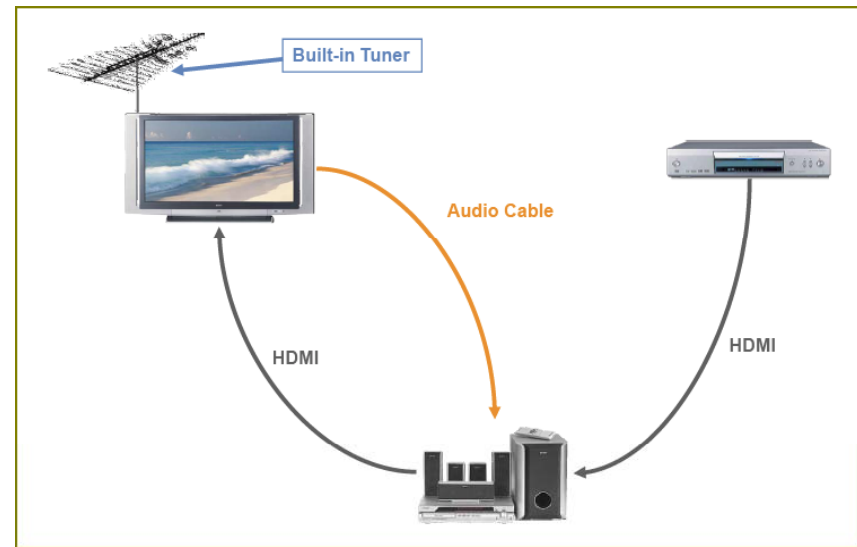
Local Area Network

- Advanced Bi-Directional Communications Channels Such As Ethernet And/Or USB
 - Sharing an Internet Connection
 - Integrated USB Hub
 - Content Distribution – Devices Will Be Able To Exchange Digital Content In Native Format, Enabling Recording, Storage, And Playback Options Across A Connected System, With No Need For A Separate Ethernet Cable



Audio Return Channel

- Deliver Audio “Upstream” From A TV To An A/V Receiver For Processing And Playback
 - In Cases Where A TV Features An Internal Content Source, Such As A Built-in Tuner Or DVD Player, The Audio Return Channel Allows The TV To Send Audio Data Upstream To The A/V Receiver Via The HDMI Cable, Eliminating The Need For An Extra Cable



TMDS' New Cousin *DisplayPort*



DisplayPort

- Digital Display Interface Standard Put Forth By The Video Electronics Standards Association (VESA)
 - Royalty-Free
 - Current Version 1.2 Was Approved On December 22, 2009.
- 1, 2, Or 4 Data Pairs In Main Link, Also Carries Clock And Audio Signals
 - Video Signal Path Supports 6 To 16 Bits Per Color Channel
 - DisplayPort Embeds The Clock In The Data Signal
 - Not Compatible With HDMI

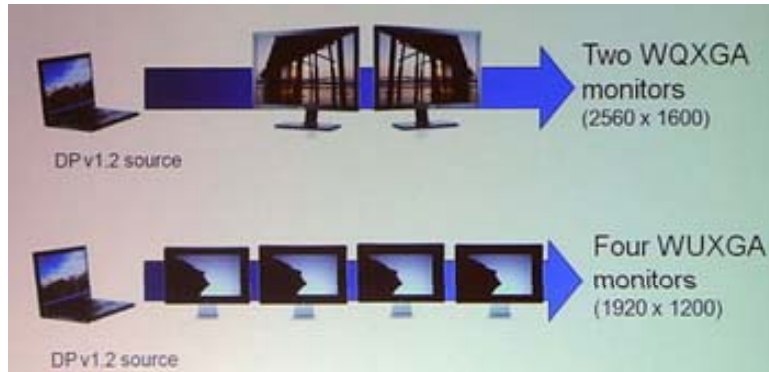


DisplayPort Cont'd

- Bi-directional Auxiliary Channel (At A Constant 17.2 MBit/S) Carries Management And Device Control Data For The Main Link Using VESA EDID And VESA MCCC (Monitor Control Command Set) Standards
- DisplayPort Technical Advantages:
 - Slimmer Cables, Smaller Connector That Doesn't Require Thumbscrews
 - Based On Micro-Packet Protocol, Not Serial Data Stream
 - Easy Expansion Of The Standard
 - Multiple Video Streams Over Single Physical Connection (Introduced In Version 1.2)
 - Long-distance Transmission Over Fiber Optic Media
 - Designed To Support Internal Chip-to-chip Communication
 - Drives Display Panels Directly, Eliminating Scaling And Control Circuits And Allowing For Cheaper And Slimmer Displays. Will Replace Internal LVDS Links
 - Supports Both RGB And YCbCr Encoding Formats
 - Auxiliary Channel Can Be Used For Transmitting Bi-directional USB, Touch-panel Data, Etc.



DisplayPort 1.2



Multi-streaming” — Transport Multiple Independent Display And Audio Streams Over A Single Cable

- Daisy Chain
- Hub Configuration
- (2) 2560 X 1600 Monitors
- (4) 1920 X 1200 Monitors

- 3840 X 2400 60hz Resolution
- Bi-directional Data
 - USB 2.0 or Ethernet

2560 x 1600 (WQXGA resolution) is supported over all 2-meter “DP Certified” cables. Some cables, due to their design, may be capable of supporting 2560 x 1600 resolution over lengths longer than 2 meters

<http://www.displayport.org/consumer/?q=content/f>



Questions ?



Thank You!

