REVIEW ON HIGH-DEFINITION MULTIMEDIA INTERFACE (HDMI)

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ABSTRACT: There are various techniques used to transmit the data in recent years. Earlier, all the techniques transmit the data in the analog form and slow data rate. The main goal of HDMI is to give transmission medium between devices with higher bandwidth and data rate. In earlier IBM, introduce VGA cable for their computers, which is capable to transfer only video signal. This means that for audio signal we have to use another cable. While HDMI is digital standard and capable to transfer multiple channel in single transmission with better data rate.

Key Words:

I. INTRODUCTION
Due to increasing in technology, people want more speed of data transfer and higher resolution of video. After successful of DVI/HDCP in the television market. The consumer electronics manufacturer see the need of digital interface. The goal of the new television is to transmit video in single channel with higher data rate. There also see the better resolution and more color space as well as high quality of video. In recent, people use VGA cable for transmission, which is only capable of one channel at a time. It is analog standard so it is usually use in computer. While HDMI is digital standards which is used in computers setup-box and smart television.
In April 2002, the HDMI working group was announced, consisting of Hitachi, Panasonic, Philip, Silicone image, Sony, Thomson, and Toshiba. The goal of this working group is to define new digital interface for transmission of data with faster rate.
In December 2002 the first specification of HDMI version 1.0 released.
In this review paper, the multiple technology of data transmission are compared with HDMI with their electric specification, signaling and encoding. It is also compare the video and audio format supported with their device control capability.

II. HDMI ARCHITECTURE
The HDMI block diagram is shown in figure 1. It consist of source and sink. The components in the HDMI device are responsible for majority of electrical signaling and logical function of transmitter and receiver. HDMI has three separate channel for data transmission in single cable and TMDS (Transition Minimized Differential Signaling, DDC (Display Data Channel), and optional CEC (Consumer electronics Control).

Figure 1 The HDMI block diagram

HDMI (High Definition Multimedia Interface) is medium of audio/video signals for transmitting uncompressed video data and audio data between HDMI compatible devices. In other, such as VGA, DVI needs separate cable for transmitting audio and video signal. While HDMI do that work in single cable with digital transfer.
There are various version is available in the market with different data-speed, resolution, multiple channel support and different pixel. The first version (HDMI 1.0) has the maximum of 165 MHz TDMS dock and 4.5Gbit/s bandwidth per link. Day by day different versions released with higher bandwidth and capability to transmit other signal and increased clarity of video and audio signal in each version.

III. VGA vs HDMI
VGA is Video Graphics Array [4]. IBM introduced VGA cable to the world. It is release to transmitting video signal only. IBM use this cable to connect the computers. VGA is purely analog standard, which only support one channel at a time. Therefore, it is not possible to transmit multiple signal with one cable.
It is also used in TVs, cameras, and smart computers. While VGA is only used in computers. From version 1.0 to 1.4, HDMI is introduced by several groups of companies. The main goal of HDMI is to transmit multiple signals in a single cable with higher data rate and better clarity. HDMI is purely based on digital standards. Therefore, various resolutions arrived from 720p, 1080p to 3820 (cinema) with better clarity. Below shows the different HDMI cables.

VGA architecture shown in below figure

There are 5 signals maintained by VGA monitors: Red, Green, Blue, Horizontal sync, and Vertical sync. VGA controller generates two video signals horizontally and vertically, forming data transfer. The horizontal sync pulse shows the line of frames while the vertical sync pulse shows the frame. The Hsync pulse covers the start and end of the line and starts sending the active data between that on monitor. It is called the active area of the frame which is actual video data. Actual video data pixels are sent to the display within a 25.17 μs window. The hsync signal drops low a minimum of 0.94 μs after the last pixel and remains low for 3.77 μs. A new line of pixels can begin a minimum of 1.89 μs after the horizontal sync pulse ends. So a single line occupies 25.17 μs of a 31.77 μs interval. The other 6.6 μs of each line is the horizontal blanking interval during which the screen is dark [5]. Below show the timing diagram.

Figure 2 VGA Architecture

HDMI have 3-channel for data transmission and each channel has 8-bit data, 2-control bits and 4-bit of auxiliary data and a TDMS clock for data transfer [6]. It will convert the main clock to TDMS clock according to data. Thought it have fixed number of data bits (8-bits) it can transmit more than that by TDMS clock. For example for 3-channel it send 24-bit data at single clock. But, if we want to transfer 30-bit data than it will adjust the frequency of TDMS clock. Below show the figure of channel.

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While, VGA has one common clock and has R, G, B, Vsync and Hsync data as shown in figure 2. So, at a time we can send up to 24-bit data. For more than that it will not send.

HDMI have the three operating period: Video Data Period, Data Island period, and Control period. During the Video Data Period, the actual video data pixels of an active video line are transmitted. During the Data Island period, audio and auxiliary data are transmitted using a series of packets [6]. The Control period is used when no video, audio, or auxiliary data needs to be transmitted. A Control Period is required between any two periods that are not Control Periods. HDMI send the data in the format of 10-bit. If data is smaller than that it will make 10-bit using some algorithm.

In other hand, VGA have no fixed mode it just start sending video. All the data is controlled by hsync and vsync. VGA has no algorithm it will just send the data in the form of 8-bit.

VGA cable is design to transfer video signal. So it cannot transfer audio. For audio transmission it need extra audio cable. In other hand, HDMI can transfer audio with video in single cable. Audio data is transferred in data islands period during blanking intervals.

VGA cables has length issue and subjected to signal interference. So more than 4-feet the analog video about to lose or break down. While HDMI is less affect from crosstalk. But it suffer if the field is magnetic field.

VGA exhibits less input lag. Input lag is referred as delay between display devices. VGA do not apply post-processing on input. While HDMI do some post-processing on input to decode better image. Post-processing is like use some filter to make better image. VGA has no quality image while HDMI has more quality image than VGA cable.

IV. HDMI 2.0 vs HDMI 2.1

HDMI 2.0 version have following features,

- It transmit video with higher dynamic range (HDR), which means it cover both the lightest and darkest areas of frame without losing any details.
- It has 4k resolutions @50 and 60 hz clock rate. The video has 4 times clarity than previous versions of HDMI.
- It gives maximum bandwidth of 18.0Gbps.
- It transmit dual video stream with simultaneously delivery to more users on same display.
- It support wide angle of 21:9 video aspect ratio.
- HDMI 2.0 does not require new version of cable or connectors. Current cable is
It support maximum of 10K resolution at 120 Hz. the picture below show the difference of 10K and 4K resolution.

- It gives maximum bandwidth of 48Gbps. More than 18Gbps, it require “Ultra high speed with Ethernet”cables which shown in following figure.
- It support dynamic HDR which covers the whole areas and details without losing information.
- It enable the Quick Media Switching which means it eliminate the delay between changing scene or content.
- It use DSC (Display Stream Compression) algorithm for video format, which is higher than 8K resolution.
- Auto Low Latency Mode (ALLM) allows the ideal latency setting to automatically be set allowing for smooth, lag-free and uninterrupted viewing and interactivity.
- The newer HDMI Cable supports the 48G bandwidth for uncompressed HDMI 2.1 feature support. The cable also features very low EMI emission.
- It also add Enhanced Audio Return Channel (eARC) format which gives higher quality of audio and support advanced audio format.

HDMI 2.1 require “Ultra high speed with ethernet” cable for more than 18Gbps bandwidth. The other features are use with existing cable. The cable shows in below is ultra-high speed cable.

CONCLUSION
Newer version of HDMI is enhance the transmission of video and audio with multi-channel and higher data-rate as well as higher resolution. It also enhance the picture clarity with 10 times more than older VGA and previous versions of HDMI.

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