Tutorial for DVI and HDMI connections

SECRETS of DVI:

It is mandatory to understand the DVI connection before moving onto the HDMI world which has a lot more traps than the original DVI standard. The biggest advantage of DVI over analog connection is the much better picture quality at higher resolutions and the originally intended simplicity for connection between computer graphics card and display. Unfortunately this only was true in theory.

Once you connect a DVI display to a computer, the graphic card driver starts looking for the EDID table. This is usually done during boot up and can be forced by replugging the connector. This communication is using the so called DDC Bus, actually the same wire that is transporting the HDCP communication. A typical EDID table can be seen here - click. The DVI EDID table is 128 Byte whereas the EXTENDED EDID used by HDMI may be 256 Byte.

The HOT PLUG signal (separate pin) shall be detected by the graphic card driver software and initiate the relearning process of the displays EDID. Unfortunately this is the first trap in the PRO AV business because I have seen numerous releases of graphic card software that was failing to do this right. That eventually means that if you are using a switch or a matrix with such poor software that once you have disconnected the display you will never get a picture back unless you reboot the PC. Even if the graphic card driver detects the hot plug signal in the right way, it might take several seconds before the picture reappears due to EDID communication.

Probably the poorest idea of the DVI inventors that the system has no way to detect if it is a first time connection between source and display or just a switch.

To fix these problems we have EDID simulators like the DVIPAL, EDIFIX or DVIFIX. The EDID table provides the PC software a combination of resolutions and frame rates that will appear later in the Properties menu as seen in the picture below:

As you can see the highest possible resolutions this monitor is able to display is 1280 x 1024.
As soon you are using a DVI display the selectable resolutions are determined by the EDID of the connected display! This is important to understand as it is also the source of the problems associated with HDMI and DVI.

As you have now learned that the displays EDID is determining the selectable resolutions in the properties window it also means that there is no way to choose anything that is not listed there. As there are many situations where a manual override is necessary a smart Taiwanese company has created a software that will actually provide full access to the timings of the graphic card.

You can download the package here:

http://www.entechtaian.com/index.shtm

The software is called POWERSTRIP and is the international standard for solving problems associated with poorly programmed graphic card drivers. Not only it ignores the EDID but also give you full access on all video timings.

BUT - be careful now that you can adjust settings that are not supported by your display you may end in the black picture loop. If that has happened you have to boot your PC in protected mode, press F8 during boot up and then search for pstrip.ini and delete it.

On Entech's website you can also find a tool that allows you to retrieve EDID data of any display, it is called moninfo.exe and we strongly recommend to have it at hand for debugging a system.

Back to EDID problems. Our professional matrices have build in EDID management that will improve your switching time and can force the source into a single resolution. Therefore you can provide only the resolution to the graphic card driver (e.g. 1280 x 1024) that you want the PC to output. So no client can screw with the graphic card driver setting later. This may be programmed individually for each input. The simplest way is to use the EDIFIX or DVIFIX.

This versatile tool can learn any displays EDID or you use one of the 50 preprogrammed resolutions and 11 memories for any kind of audio and video EDID information.

**EDID forwarding if there is no EDID management:**

This is probably the source for most problems as soon you are using a switcher that has no programmable EDID for each input. In fact anytime you connect the source to the display the EDID information should be forwarded from display to source. Unfortunately some graphic cards and there associated driver are not detecting the switch and therefore the screen goes blank. I assume that either the hot plug signal is not detected or the timings of the communication are the reason for the failure. As there are no means to know what is happening on the DDC bus unless you have a logic analyser at hand, it is quite useful to have one of our tools at hand that will trick the source and hide the hardware that is used behind the EDID simulators.

**NEW PROBLEMS with GRAPHIC CARDS and long DVI cables**

Recently we stepped over a new problem with a RADEON based graphic card and it really seems that these engineers are not testing their designs any longer. This 2600 model has a very bad DDC bus driver, which results in problems reading EDID with cables longer than 10 meters. A SONY PS3 had no problems reading the EDID in the same setup with DVIFIX at the end of 70m of our cable. SO BE VERY CAREFUL WITH EDID and long cables runs, and also be aware that integrated fiber cables (they look like copper DVI cables) have copper wiring for the DDC bus which virtually means that if you use those with the above graphic card, you would not be able to retrieve EDID from the display with runs longer than 10 meter.
**Tutorial HDMI connections**

**SECRETS of HDMI:**

Now that you have learned about DVI and its secret it is time to talk about the additions that are coming with HDMI. Since HDMI has now been revised 3 or 4 times to become HDMI 1.3a it became quite a monster that hardly anybody can understand any longer. I will not go into details about the differences of HDMI but here is a link to a comment Jim Peterson of Lumagen once made – check out this other document in the SPATZ ACADEMY.

The major difference to DVI is the addition of Audio to the video signals. For the fact that the audio is transmitted on the same physical wires as the video signals, you can use DVI cabling and still be HDMI 1.3a. The audio is multiplexed in the video data stream which inherently means it is also encrypted with HDCP. That was the whole idea of the founders, they are preparing a path to charge you on what you are watching and listening. A future scenario could be that you have an Ethernet connection to the net and choose online which audio format and what video quality you are going to watch and listen and pay for it respectively. SCARY!

You are buying a BluRay or HDDVD which has all recorded but without the online connection you are stuck with DVD quality and stereo sound. Yep that is possible with HDMI !!!!

Ok let us assume you have no restrictions of what you are allowed to do which still requires a lot of communication between source and display. Once you have connected the wire the Hot Plug signal should start an initialization sequence where the source starts reading the EDID of the HDMI source. In addition to DVI this EDID can have 128 BYTE more data making it a 256 BYTE for both RAW EDID and EXTENDED EDID.

Look at a combined HDMI/DVI EDID - click here.

As you can see this EDID (from HDMI4X2) supports both HDMI and DVI resolutions but in the real world you can end up with displays that will not allow PC resolutions over HDMI - click here for an example.

This EDID from the EIZO HD2441 only contains HDMI resolutions making it impossible to get a graphic card working unless you use an EDID simulator inbetween the PC and display. The same is true for the audio signal - the display is telling the source what it can decode or receive and then the source will output what is marked as native in the displays EDID. That could be e.g. 1080i@60 and 5.1 digital audio. In an ideal world the source would then allow you a manual override of what is supported by the display.

Unfortunately this is not true for most of the sources you can buy today, like the PS3 or the Toshiba HDDVD players. PS3 has a powerful tool, which is the automatic search for video and audio setting. This is nothing but checking the EDID of the attached sink and what information is stored there. It might be that the PS3 is offering you 4 choices of output resolutions that you can automatically select. That means you have virtually no control of what the PS3 does unless you mark only the one resolution you want (e.g. 1080@60p). If your display is not supporting this resolution then the PS3 is falling back to 576p. However if you play a video game the native resolution will be 720p and if you have not marked the 720p then the PS3 will downscale the game signal to 576p.

This is all happening automatically. The 1080@24p of the PS3 is even working more strange. It will only output that signal when you actually play back a BluRay disc. Once you stop the disc and you are back at the control page your output resolution could easily be 1080i, 720 or 576p depending on how you configured the system menu and on what your displays EDID is telling the PS3.

Now imagine you are using a switcher or matrix with more than one source and more than one display connected.

This brings me to another story that I recently had to deal with. A customer was using a BluRay and HDDVD player that he wanted to run through a switcher and feed 2 displays. Unfortunately the one
display only supported RGB color space and no YPrPb. So what the customer would have wanted to do is to programmed both sources to output RGB instead of YPrPb (which is native with HDMI) but to no avail. Both sources would rely on the transmitted EDID of the source to select automatically what color space they would use. In this case the second display was sending the YPrPb EDID to the sources making them output YPrPb instead of the RGB color space that both displays would have been able to handle.

As the switcher is a low cost product there was no way to manipulate the EDID for each input separately and fixing this problem. We finally have written a special firmware that allows you to convert the YPrPb input signals to RGB at the output of the switcher.

Our BARRACUDA switcher has per input programmable EDID using the OSD MENU giving the installer full control of what EDID is transmitted to the sources. It will also support EDID pass and EDID learning capability. In the PASS mode the switcher will behave like most units on the market and pass the EDID of the display to the source with every switch you make. This is no different to an initialization sequence with the long time before you get an image back and with all the problems that are associated with EDID information exchange.

So this should be avoided and if you do not want to use the programmable EDID you would still be able to learn your display in all the 4 EDID memories. In this case the sources will just think they are connected all the time, without reinitializing the EDID information.

Another stand alone solution for these problems is our HDMI SingleEDID Emulator the HDMIFIX. This small very powerful EDID simulator will give you the full control over the EDID information for both audio and video. As you may choose settings that are not supported by the display you probably end up with a blank screen but this is still more preferable than having a blank screen and not knowing why. In fact we also have spent the unit a serial port that will allow you a remote change of the EDID or firmware update. I will try to explain why such a device will be mandatory for some applications and a very useful tool to avoid headaches in other setups. The problems are starting with 2 differened models of displays with 2 different EDIDs. For 2 sources and full flexibility it will be necessary to use a HDMI matrix with 2X2.

**Here the possible switch configurations:**

**Source A or B displayed simultaneously at output 1 and 2:**

(same for a 2 output DA)

In this scenario the matrix would have to read the EDID of both sources and find the intersection of both display EDIDs. A very complicated task considering the several thousands of combinations made out of color space, resolution, frame rate, video timings and multiple audio formats that are supported by HDMI. So you can imagine that this process requires computing time also meaning blank image for several seconds !! No way switching back and forth quickly.

An alternative approach is the readout of the EDID of output 1 and assume that the display connected at output 2 has similar capabilities. If not it might be that one of the 2 displays stays blank or even both because the source is confused not outputting any signal at all.

Using the HDMIFIX at both inputs lets you program the EDID you want and avoids long switching times. The sources does not even notice that the signal routing has been changed.

**Source A displayed on output 1 and source B displayed 2:**

Now this new configurations should force Source A to read out the EDID of Display at OUT 1 and Source B to read out EDID of display at OUT 2. If you are lucky the sources have detected this change of routing and make a complete and succesful reinitialization.

If not you end up with a blank screen. To make things more complicated I have seen sources that
would not store user adjustments but go back to factory defaults (native resolution) after they recognize a Hot Plug. In this case the firmware designer has just forgotten that his equipment might be used with an AV receiver, switcher or matrix. Professional matrices have build in EDID memories just because of this behaviour of DVI respectively HDMI. Our cost effective matrices are rereading EDID with every switch with all the possible problems already described. I am pretty sure that most installers want reproducible results with any display and any source and will start using the HDMIFIX in every setup. We do have the DVIFIX available now but it is more of a professional device with additional functionality. Several of our customers are using these in front of switchers or matrices in the big retail stores that have large networks of distributed HDMI signals for up to 200 displays (SATURN market in Berlin, biggest in Europe).

The DVIFIX has reduced their switching times significantly and also fixed the problem that after a switch some displays never came back to life. As you have learned there is a lot of room in the HDMI standard to make connections problematic and extremely difficult if your setups become more complicated. Compared to Component it is a nightmare and I recommend any dealer or installer that they should get familiar with it asap. The future path will be HDMI looking at PS3 that has not HD component output at all. Your customers want a futureproof system which includes HDMI.

**One word on the 1080@60p discussion:**

It is absolutely not true that BluRay or HDDVD is recorded in 1080p@60Hz and that this is therefore the most desired output resolution. This would require way too much space on the discs. It would be a waiste to encode 60 frames out of the original 24. So no more than 24p original frames have been used in the encoder. Out of these 24 frames the encoder e.g. looks for full frames and then only encodes changes of the next 12 frames before it encodes another full frame. This example is older MPEG encoding scheme and is more refined with newer more efficient codecs.

The codecs are actually using progressive frames and video data changes between them. The final decoding of this stream might end up in an interlaced or progressive output format.

For the fact that the video signal has been derived from a progressive source it does not really matter how you are outputting it. The output device of the decoder would split the progressive frame in two interlaced fields that may either be recombined in the player making it 1080p or later in the display making it a 1080i signal that requires half the bandwith for all following components.

So if you are using 1080p instead of 1080i you may test and decide if your display is better at recombining the original frame or your player. The player might have the easier job depending on how it is constructed internally and then know exactly which fields belong together.

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