Blu-Ray HD Playback for Video Projection

Author: Mark C. Brown
Systems Engineer, BEE
www.reachcomm.net
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Introduction

Houses of worship, schools, and users of corporate conference rooms often want to use Blu-ray players with their video projection systems and flat panel displays, and understandably, they expect HD image quality when they do this. However, often they encounter difficulties, or questionable image quality (or no image) when they try to do this, and the solution is not always easy to sort out. In writing this application note, I'm hoping to help de-mystify this topic.

I'll begin with a summary of the basic principles to consider, followed by my observations, and a list of references for more information on the details.

Basic Principles

1. HD = High Definition ("Hi Def"): 1080p, 1080i, 720p, 720i, resolutions, 16:9 aspect ratio

2. SD = Standard Definition: 480i resolution, 4:3 aspect ratio

3. Typical Video Projector Resolutions: The most common native resolutions for projectors are XGA (1024 x 768, aspect ratio 4:3) and WXGA (1280 x 800, aspect ratio 16:10), at the time of this writing. Essentially a WXGA projector will achieve the full benefit of a 720p source, i.e. 1280 x 720 (i.e. 16:9, HDTV aspect ratio). In this sense, a WXGA projector is usually considered High Definition.

4. Blu-ray 1080p resolution: This translates to a pixel field of 1920 x 1080. To get the full advantage of Blu-rays's maximum 1080p resolution, you would need a video projector with the same native resolution or better. Such a relatively high resolution is possible, but not the most common for projectors at the time of this writing. (Even so, projectors with WUXGA 1920 x 1200 resolution are readily available, although more expensive.)

5. High Definition Signal Methods: Baseband video with high definition resolution can be transmitted over analog RGBHV (e.g. using a VGA HD15 connector, or five separate BNC connectors for RGBHV), and also over analog component video (typically 3 RCA connectors on consumer gear), as well as digital (DVI or HDMI) interconnection schemes.

6. VGA-type Sources for High Definition Images: VGA-type sources of higher resolution, such as WXGA (1280 x 800) and WUXGA (1920 x 1210) can be considered similar in resolution to "High Definition" resolutions, also known as HDTV resolutions. (In this sense, I use the term VGA not as a resolution, but as an analog video connection format used for transmission of RGBHV signals over HD15 connectors.)

7. DVI Sources for High Definition Images: DVI stands for "Digital Video Interface." On computers, a connector type known as a DVI connector is typically used, but DVI signals can be used on other types of connectors. In particular, HDMI uses DVI signals for video transmission. Computers use DVI to provide video images with resolutions such as XGA, WXGA, and WUXGA resolutions that are common in video

projection systems. DVI works well for higher resolutions, with the resulting image being less affected by noise and other influences.

8. HDMI: This stands for High Definition Multi-media Interface. It includes both DVI video and Surround-Sound audio signals on a single, compact connector. When used with a projector system in an auditorium or similar large room, typically only the DVI video signals from the HDMI connector are used by the projection system.

9. Another major issue – HDCP: High-bandwidth Digital Content Protection (also sometimes unofficially defined as "High Definition Copy Protection") is a copy prevention scheme intended to protect commercial producers of high-definition content. This is a form of digital rights management for video recordings. It requires that all devices in a digital video signal chain must be HDCP-compliant, to make sure none of them are copying the content. This means that any projector (or other display device) must be HDCP-compliant. The only way the display can be compliant is if it has a digital video input port, such as DVI or HDMI, and even in that case it must have internal electronics and software that make it HDCP-compliant. Otherwise a Blu-ray player will not send its highest definition content to the projector or display. A projector that has a DVI input port does not guarantee that it is HDCP-compliant. The projector manufacturer will specify that the unit is HDCP-compliant, if it is.

10. High Definition over Digital connections (HDMI, DVI) vs. Analog (Component Video): High Definition resolutions of 1080p and higher can be transmitted over analog connections, specifically over Component Video (analog red, green & blue jacks, signals Y- Pb- Pr). However, Blu-ray players are designed so that they send a maximum resolution of 1080i over component video, up until 2011 (see more on this below, i.e. "Analog Sunset"). The intent is to prevent or discourage copying of high definition content that is produced commercially. This cannot be controlled over existing formats of analog connections. With DVI (which is also used within HDMI), the format of this digital connection facilitates HDCP control, so high def producers want this to be the way high def content is delivered to your display device (TV, flat panel display or projector).

11. Possible Big "Gotcha" When You Have an HDCP Compliant Switcher or DA: If you have a Blu-ray player (or other HDCP compliant source, such as a MacBook Pro) connected by HDMI or DVI to an HDCP compliant switcher or DA (i.e. Distribution Amplifier, such as HDMI or DVI splitter), you will likely have a problem unless everything else is HDCP compliant. For example, maybe your projector is not HDCP compliant, or maybe your output cabling from the switcher or DA does not facilitate HDCP (e.g. if you use VGA cabling instead of DVI or HDMI cabling). In this case, you're likely to get a black screen or screen full of snow. This is because the HDCP compliant source (e.g. the Blu-ray player or MacBook Pro), having detected an HDCP compliant device (the switcher or DA) is sending an HDCP encoded data stream. However, the cabling or the next device in the chain does not support this, so you get the black screen or a screen full of snow.

12. Is SDI a Solution with Blu-ray Players? – The answer is "No." By definition, SDI (Serial Digital Interface) does not carry HDCP encoding, or any other form of copy protection in the digital signal. This is because SDI, also sometimes referred to as HD-SDI when used for Hi-Def, is a video signaling standard intended for broadcast & video production studios, and similar professional video environments. It is also found in high-end video projection systems, because of the advantages of SDI cabling and other factors. On the other hand, Blu-ray players are consumer devices, designed for home use and similar situations. SDI is definitely intended for High Definition capability in professional environments, but not for Blu-ray players with only HDMI out and HDCP-compliance. (Of course, SDI can be used for hi def signals converted from analog component video directly to SDI.)

13. "Analog Sunset" for Component Video on Blu-ray Players: This is scheduled to happen over the period of 2011 to 2014, as detailed in various references below. Basically, starting in January 2011, new models of Blu-ray players do not pass HD over component video connections. Probably many new models (and eventually most) will discontinue having component video connectors.

Observations

If you want to use a Blu-ray player to get high definition resolutions from commercially produced content, used in combination with a video projector or flat panel display, there are 2 ways to do this.

First, for projectors or displays that don't have HDCP-compliance, or even if they do, if you're using a non-digital video connection (e.g. VGA or RGBHV, instead of DVI or HDMI), then you need a pre-2011 Blu-ray player that has component video output. This can be connected through a switcher/scaler and DA, or directly to the projector or display. You would typically use the Blu-ray player for 720p output resolution in this case, which will line up most closely with the native resolution of a WXGA projector. (Alternately, the best resolution you can get from this Blu-Ray player is 1080i out of the component video connectors, but this would require a projector or display with a native resolution of WUXGA or better, and a pre-2011 Blu-ray player.)

Second, for projectors and displays that have HDCP-compliance, then you need to use a digital video connection path (i.e. DVI or HDMI) to connect from the Blu-ray player to the projector or display. If you go through a switcher/scaler or similar, then the switcher/scaler must also be HDCP-compliant, and you need to use digital video ports for both input and output on the switcher, as well as a digital video input port on the projector or display. If you use a DA, it must also be HDCP compliant, and you need to use digital ports in and out on the DA.

Note, these concerns apply to Blu-ray players used for high definition commercial content. If you're using a computer for high resolution graphics, or for showing your own in-house high definition video clips, or you're sending high resolution video from an in-house camera mixer or similar, then you can send these high resolution signals over any existing VGA or RGBHV cabling without changing anything, and you will get high resolution results. Or at least you'll get the highest resolution possible for your projector or display, and for your signal processing. It's the Blu-ray player, or other HDCP compliant device, that's causing a resolution limitation.

For new projectors, new switcher/scaler units, and new video cabling installations, it is clear that the issue of HDCP compliance and the related digital cabling required must be part of the decision making process, including whether the users require this capability. Trying to accommodate HDCP compliance adds headaches and significant cost, but with the demise of high def signals on component video outputs from Blu-ray players, this issue is forced into the discussion for new systems. As part of this discussion, it must be considered that protected material is usually restricted from playback in public and commercial spaces, and this fact also deserves some thought.

Conclusion

By understanding the basic principles involved, and considering my observations discussed above, you should be able to achieve the best possible image quality for your specific system when you play DVDs or BDs, even if it isn't the highest resolution possible from your Blu-ray player. In most cases you can achieve some form of high def, although it's getting harder with the design changes that are being implemented on new Blu-ray players.

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