High Definition Content is Here – and in Demand

When we refer to HD content, we are specifically addressing video and image content created to HD standards (720p and 1080p), which have become *de facto* for video production, especially as broadcasters march toward the February 2009 deadline mandating the termination of analog standard-definition broadcast signals.

Digital signage network owners want it, and consumers expect it. As consumer HDTVs are adopted by a broader mass audience, people expect to see a higher level of picture quality everywhere they go. The bar has simply been raised.

In addition, HD content just makes better sense for many digital signage applications, which often contain graphical and text-heavy content and still images. With relatively low quality 640 X 480 standard definition content, the human eye is more forgiving when it is moving video, such as a movie or television commercial. With still imagery, especially text, however, 640 X 480 looks far worse, and is downright unacceptable for informational screens such as menu boards and directional signage.

Also driving the adoption of HD content is the "widescreen mandate." Digital signage is nearly universally deployed on large screens, and large screens are, without exception, wide screens. Standard-definition content at a 4:3 aspect ratio, therefore, cannot satisfy this mandate and must be scaled or distorted to fit widescreen displays. HD content is produced in a 16:9 format and is therefore more suited for display on large screens.

So, given that all of this HD content exists and needs to be seen on digital signage networks, how it is best done?

To fully understand these issues, it is necessary to first examine the technology, then determine the most cost-effective and reliable technological solutions for the delivery of and display of HD content. There are specific issues relating to the challenge of delivering this content to digital signage networks.

What is "High Definition?"

This is a deceptively simple question with an answer that it is more complex than one might assume.

"High Definition" refers to a set of specific standards defining not only display technology but digital video encoding and broadcast as well. The now-familiar monikers of "720p", "1080i" and "1080p" represent specific technical standards. However, these standards define not only the pixel resolution of content, but how it is encoded and stored, transmitted to a display and ultimately shown to the viewer as millions of dancing pixels on a large-screen display.

Therefore, the delivery of HD media requires proper attention to equipment and processes from end-to-end, from the encoding of digital media files, to the transmission of the digital video data, to the display on which they are shown.

"High Definition" and "High Resolution" are not synonymous

Digital signage content is often "high resolution", but not necessarily "high definition". Quite often, content coming from digital signage systems, particularly PC-based ones, is showing a collection of video, images, text etc. on a large display. From a basic technical perspective, this is simply a PC set to a high resolution connected to a large monitor; not really any different from the PC and monitor you may be sitting at right now. Think of how this differs from, for example, a Blu-Ray DVD player connected to a television and you can begin to see how different the approaches actually are.

The challenges inherent in supplying high-definition digital signage is primarily concerned with how to take HD-encoded media files and move them to the displays in the most straightforward and reliable way possible.

The Media Player vs. the PC

There are currently two distinct technologies for deploying HD media: PCs with proprietary software and digital signage media players. PC-based software systems are complex and expensive and may be "overkill" if the project does not require more advanced functionality such as live data feeds. [1]

In applications involving HD media content, media player appliances provide numerous advantages in price, reliability and size.

Media players are small, solid state, special-purpose appliances designed and built for the task, using specialized hardware-based decoder chips to play media flawlessly. The units also contain video output chipsets that provide HD signals (720p, 1080i, 1080p). Another advantage is solid-state storage, such as CompactFlash memory cards, to locally store content for playback. The devices can be standalone or connected to a network. Control of the devices is achieved through a built-in interface and/or a central management system that reaches out to the unit via a network or the internet. The content management workflow consists of scheduling and distributing media files for display on the devices.

PCs, on the other hand are built for general-purpose computing, with media playing being only one aspect of their functionality. While PC hardware and architecture provides a powerful platform, most of that power goes to waste in a media playing application. In addition, PC hardware utilizes fragile components such as hard disks and heat-generating processors and the high overhead of desktop Windows or Linux is not the ideal platform for unattended 24/7 operation. Lastly, the physical size of PC hardware can present installation challenges in the field.

AGNPRO's miniBox line of media players provide all of these advantages and more. The miniBox 700 series players provide true 1080p output for the highest quality video available

[1] For in-depth information on this topic, see our whitepaper *Choosing the Right Tool for the Right Job*

The Computer Monitor vs. The TV

It is important to understand that there are two video standards at work when digital signage hardware is connected to large displays. One is rooted in the PC world and is based on VESA standards (VGA, SVGA, XGA, WXGA etc.), the second derives from consumer electronics and is based on HDTV standards (720p, 1080i, and 1080p). These standards are not interchangeable and interoperable, and they are carried over different, or sometimes the same, physical connectors.

PC-based digital signage systems connect to displays the same way a desktop PC is connected to its monitor, using standard VESA resolutions such as 1360 X 768, while media players generally use high-definition video standards such as 720p and 1080p. PCs connect via analog RGB (VGA) or DVI. Media players generally supply an HD signal through DVI, HDMI, analog RGB and sometimes component video.

Potential problems exist when connecting PCs to televisions because most televisions have limited support for PC VESA resolutions. This can be rectified by using more expensive pro A/V quality multi-synchronous displays that support a wide range of VESA resolutions. However, the reality is that network owners prefer to purchase consumer televisions due to the fact that in most cases they can be half the cost of pro A/V equipment and offer an equivalent picture quality.

Media players offer better connectivity options for televisions because they support consumer electronics video standards including 720p and 1080p over standard television video inputs like HDMI and component video.

HDMI – The new Kid on the Block

HDMI (High Definition Multimedia Interface) is firmly establishing itself as the standard method of delivery for high-definition content to televisions and has replaced the DVI standard. Current televisions universally ship with HDMI input ports, not DVI.

Using HDMI has its own set of advantages and disadvantages. On the plus side, HDMI cables and connectors are more compact and thinner than both analog RGB and DVI and a single HDMI cable carries digital content and audio, replacing the five-cable bundle required by component video. The disadvantage of HDMI cabling is a cable length limitation. The HDMI spec indicates an effective limit of 10 meters (32 feet). Technologies exist to extend HDMI cabling, but can be expensive and relatively untested compared to tried-and-true methods like analog video over CAT-5. Also, HDMI connectors are designed with no locking or screw-down mechanism. Looking on the bright side, at least HDMI's effective limit is longer than DVI's official 5-meter limitation.

A potentially more noteworthy issue with HDMI is overscan. Overscan is a function of televisions wherein the TV "crops" the video image by 5-10%. All televisions use overscan on HDMI and each one handles overscanning according to its own parameters and design. Some displays have view mode functions allowing the user to select "full screen" or "1:1" mode which turns overscan off to show the entire picture. Also, there are slight variations in the quality of the overscanned images which will depend on how well the display's internal electronics scale the content. The best way to deal with the overscanning issue to simply design content with industry-standard "safe areas" around the edges of the frame or purchase displays which allow overscan to be turned off. If those two techniques prove to be problematic, consider that AGNPRO's HD700-S 1080p media player has a feature that allows for manual adjustment of the image size to compensate for overscan.

File Formats and CODECs: The Decoding the Alphabet Soup

Now that we've covered the basics of high-definition display, it is instructive to review file formats as well, because HD content must be encoded as such within digital video files. There is no topic that is more confusing to end-users (and even some video professionals) than making sense of the myriad of digital video file formats, CODECs, profiles and containers that are typically used.

MPEG 1, 2 and 4

"MPEG" stands for "Moving Pictures Experts Group" and is a working group of the International Organization for Standardization (ISO) and the International Electrotechnical Organization. MPEG is responsible for developing digital video and audio standards. MPEG 1, 2, and 4 are standard compression formats for video developed by this group[2].

One of the most common misconceptions is that MPEG standards are uniform file formats; that an "MPEG-4 file", for example is the same as any other.

Unfortunately, this is not the case. Each MPEG standard has sub-standards called "parts" and each part is further divided into "profiles" and "levels". "Parts" are mainly used to define a set of standards for a specific function, such as video, audio, streaming etc. "Profiles" and "Levels" are more specific standards relating to (in our case) the encoding of the video and audio data. For our purposes, the "profile" defines the subset of features such as compression algorithm and chroma format. The "level" defines the parameters of maximum bit rate (video quality), resolution (size) and frame rate. To make matters more complex, there are specific Codecs associated with levels. Codecs are very specific compression and encoding methods, often proprietary to specific software vendors.

Thankfully, the HD digital video world has largely coalesced around a few widely distributed part/profile/level/codec combinations, so we only need to be concerned with a few specific file types.

MPEG-1 is the oldest standard and is widely compatible because it is relatively homogenous with regard to parts and levels.

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[2] *Why is "MPEG-3" missing? Is it because it is an audio-only standard also known as "MP3"? Surprisingly, no. MPEG-3 was initially developed specifically for HDTV, but was later abandoned when existing MPEG-2 and MPEG-4 standards were deemed appropriate. The popular "MP3" audio format is actually an audio specification that is "Part 3" of the MPEG-1 standard. "MP3" is actually an abbreviation of "MPEG1 Part 3"*

However, there is no support for high-definition. Also. Much of the MPEG-1 standard has been incorporated into MPEG-2.

MPEG-2 is the most widely used standard because it has been adopted for use in television and DVDs. Chances are, whatever you will be watching on TV or your DVD player tonight is an MPEG-2 file. For HD content, MPEG-2 files should use "Main Profile" and "High Level". This is often abbreviated MP@HL. "High Level" allows for the higher resolution and bit rates required for HD video. The MPEG-2 codec is proprietary, but standardized, so CODEC incompatibilities are rare with MPEG-2 files.

MPEG-4 is the latest set of digital video standards. MPEG-4 offers better compression than MPEG-2, so it has been widely adopted for internet file distribution and portable video devices, such as Apple iPods.

Unfortunately, the MPEG-4 standard is fractured into several parts and levels with many proprietary and competing codecs, so the use of MPEG-4 generally causes the most confusion and frustration among digital signage stakeholders.

"Part 2" refers to the video portion of the spec. It is often referred to as "MPEG 4.2". The Advanced Simple Profile (ASP) and Level 5 offer HD compatibility. This is often abbreviated (ASP@L5). There are also proprietary implementations of ASP named "Divx", "Xvid" and "Nero". Each of these proprietary implementations is HD-compatible, but not all are supported on media players. Divx is the most widely support format.

Additionally, a new standard called H.264 has emerged from the MPEG-4 standard. This format is also known as "AVC" (Advanced Video Coding). It offers superior compression while maintaining good video quality, which is why it is used in HD DVDs such as Sony's Blu-Ray. Generally, this standard is only supported in media players with the newest chipsets (such as AGNPRO's HD700-S). For HD video in H.264, use High Profile, Level 4.0 (H.264 HP@L4.0)

Proprietary formats: Windows Media, Apple QuickTime and Flash Video
In addition to MPEG files, there are also proprietary video formats developed by Microsoft, Apple and Adobe Systems, respectively.

These proprietary formats do not conform to existing MPEG standards (although they are based on them), and generally require the use of specific player software on the desktop. The advantage to using these formats is that they provide a reliable and predictable way to ensure compatibility. The content creator does not need to delve into the world MPEG parts, levels and codecs to produce a file she knows will be widely compatible and easily previewed on user desktops.

Windows Media Video (WMV): Version 9 (WMV9) provides high-definition video as well as good quality and small file sizes. Many video decoder chip makers, including the industry leader, Sigma Designs, have incorporated WMV compatibility into their designs. This is the best choice among the proprietary file formats.

QuickTime: Apple's video file format is a favorite among video producers, but the codec required to play QuickTime files is generally not incorporated into media players. This makes the Quicktime format mostly incompatible with digital signage media players.

Flash Video: This format is the standard for internet streaming video and requires Adobe Systems' "Flash Player" on a PC. It is the format used by YouTube. Like QuickTime, this codec is generally not available in media players, which limits the use of Flash Video to the PC desktop.

HD File Sizes

One more important issue to consider when deploying HD video content is file sizes. HD files are considerably larger than standard definition versions. One minute of standard-definition, DVD-quality video typically requires a 10-15 MB, while 720p HD file sizes are often 3 times larger, with one minute of video

weighing in at 30-40MB. 1080p video is even larger: 50-60MB per minute.

Given the low cost and growing size of storage media, accommodation of these larger files is easy, and with the ever-growing bandwidth capacity of today's broadband networks, large files do not present the types of problems they used to. Some caution is warranted, however, with regard to allocating network bandwidth appropriately. It is best to schedule mass downloads for off-hour times when the signage network is idle.

Best Practices

In light of what we now know, let's answer the question posed at the beginning of this article. How do we implement a high-definition media playing project?

The following should be considered "best practices":

- Use a consistent and reliable media file format across the network. MPEG-2 and WMV are examples of such formats
- Employ solid-state media player devices with true HD support, not PC-based systems
- Decide early whether you plan to use VESA video or HD Video standards, then employ one standard consistently. Your choice may be influenced by cable length requirements.
- If you plan to use consumer-level TVs and VESA, ensure that the TV is compatible with widescreen high-resolution content.
- If you are distributing HD media files across the internet, do a careful bandwidth analysis of your current and future needs.

Conclusion

We hope this document has helped you better understand the principles and practices of deploying a reliable HD digital signage system. At AGNPRO, we our advice is always to use "The right tool for the right job", and HD media deployment provides an excellent example of this bit of wisdom. Do not hesitate to contact us if you have any additional questions.

Recommended HD File Formats for AGNPRO Media Players

Encoding	Profile/Level	Resolution	Frame Rate	Bitrate
MPEG-2	Main Profile High Level	Up to 1920 X 1080	Up to 30 frames per second	Up to 40Mbs
MPEG-4	High Profile Level 4	Up to 1280 X 768	Up to 30 frames per second	Up to 40Mbs
WMV (version 9)	Main Profile Main Level	Up to 1920 X 1080	Up to 30 frames per second	Up to 40Mbs

Further Research

If you are interested in more in-depth information on many of the topics addressed in this whitepaper, we recommend the following websites:

The Moving Picture Experts Group (MPEG)	www.chiariglione.org/mpeg/
The MPEG Industry Forum	www.mpegif.org
HDMI Licensing, LLC	www.hdmi.org/
Video Electronics Standards Association	www.vesa.org