GUIDE

Digital Signage Hardware

Deploying a digital signage network involves making choices about everything from mounting screens to the best way to deliver content to those screens.

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INTRODUCTION

Why is choosing the right hardware important?

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Richard Slawsky has been working in business journalism for more than 15 years, covering industries ranging from oil and gas to advertising to technology. He got his start with the weekly business journal New Orleans CityBusiness and was part of a team that covered the aftermath of Hurricane Katrina. Slawsky now resides in Louisville, Ky., where he teaches in the Communication department at the University of Louisville in addition to contributing to a number of NetWorld Media Group publications.

It's becoming more and more apparent that industries that don't find a way to incorporate digital signage into their operations risk getting left in the competitive dust.

Verticals from healthcare to hospitality, restaurants to retail and advertising to aviation are using digital signage to reach their customer base. Go into a doctor's office and chances are there will be a digital display offering tips on how to stay healthy. Visit any quick-service restaurant and it's probable that menu items and nutritional information are displayed on a digital menu board.

Even as the economy barely stumbles out of the malaise of the past few years, the digital signage industry continues to grow. A 2013 Arbitron study showed three-quarters of total U.S. adults, or about 74 million people have noticed advertising on static billboards, digital billboards, sides of public buses, bus shelters, taxi cabs, commuter rails, subways or any street level advertising such as kiosks or newspaper stands in the past month. Viewership among travelers is 84%.

A joint project conducted by Intel, Research Strategy Group, Ontario Lottery and Gaming, Capital Networks and EdCom between August and December 2012 looked at the effects of digital signage on non-gaming sales and offers in a casino environment. The study indicated that the use of digital signage drove sales increases on restaurant items displayed on that signage of as much as 127 percent.

Clearly, the case for digital signage has been made, and business operators are recognizing that. According to research firm P.Q. Media, digital out-of-home media, including place-based video networks, are one of the

fastest growing sectors of the so-called “Digital and Alternative Media” marketplaces. The firm estimates that the out-of-home sector now represents 11.1% of the $104 billion global marketplace for DAM advertising, which also includes Internet and mobile.

But knowing how a digital signage network is put together can be a mystery for those business operators who would rather spend their time taking care of customers than learning about digital signage technology. For them, DigitalSignageToday.com has compiled a primer to digital signage hardware.

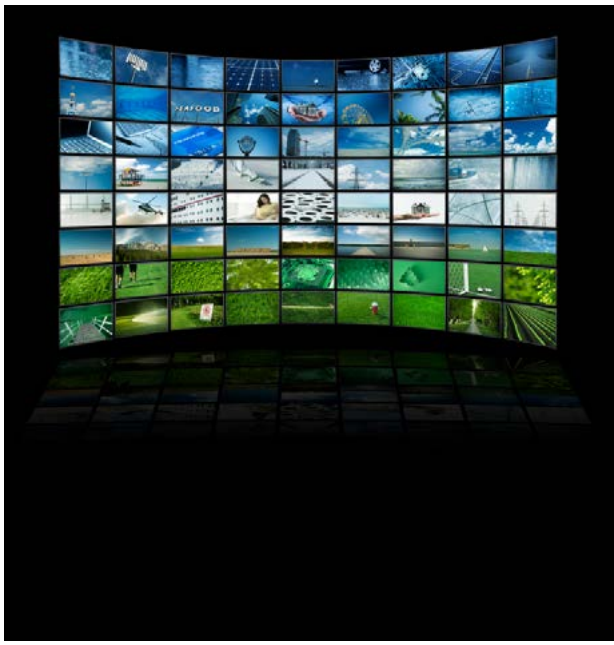
Included is information about the best type of screen to buy, considerations when choosing between a PC and a media player, information on how to deliver content to the screens and points to think about when installing digital signage

We’d like to thank technology company HP, whose sponsorship of this guide enables us to offer it to you at no cost.

About 74 million people have noticed advertising on static billboards, digital billboards, sides of public buses, bus shelters, taxi cabs, commuter rails, subways or any street level advertising such as kiosks or newspaper stands in the past month.

CHAPTER 1

The screens



Screens in high-traffic places, such as a bus depot or airport, must be designed for continuous use. Otherwise, the screen easily can become out of order, leading to a poor consumer experience.

Consumer vs. commercial

Though most flatscreen displays may look the same — 16:9 ratio screen, black bezel, multiple inputs — there is a dichotomy between consumer and commercial grade screens.

Consumer-grade screens are those that we see at Best Buy, Target and possibly in our own homes. They support high resolutions (up to 1080p), come in sizes up to 84 inches or greater and perform very well under normal household use.

But household use is far less strenuous on a flatscreen than the use it would get in, say, an airport. Airports are open all hours, which means their screens are almost never turned off. That means airport authorities and other deployers of demanding digital signage turn to commercial models of flatscreens from manufacturers such as HP, LG or Samsung.

For those considering a digital signage deployment, then, here are five reasons they should choose a commercial-grade screen:

1. The enclosures

As digital signage has matured, manufacturers have learned what works and what doesn't. One aspect of a screen that has seen significant modifications over the years is the enclosure.

A flatscreen's enclosure is comprised of a bezel which goes around the viewable area of the screen and a casing that covers the back. Commercial screens' enclosures have been toughened to withstand the "elements" involved in deployments.

For example, digital menu boards in restaurants have to withstand high heat and even grease, while screens in rail stations have to be resistant to dust and corrosion.

"Most commercial screen models also have a slimmer or more narrow bezel now," said Mike White, president of Alcoa, Tenn.-based Multi-Media Solutions. "In most cases, this makes it better for the applications, especially digital signage."

2. Inputs

When most people buy a consumer grade screen for their home, the only piece of external hardware they plan on connecting to it is a DVD player or game system. Anyone who has worked with digital signage knows that a networked screen requires a lot more than just simple RCA or HDMI connections.

For that reason, commercial grade screens provide extra inputs that consumer grade screens don't have. To accommodate the numerous types of network connections and media playing devices that may be used, commercial grade screens have PC inputs, serial ports, Legacy and VGA inputs.

Many IT-related connections are more stream-lined and less costly than audio/visual-oriented solutions. Commercial grade screens are also now being equipped with RS-232 inputs, which allow two-way communications between the screen and the sending device.

3. Heavy-duty hardware means a longer lifespan

Commercial grade flatscreens are built with heavy-duty parts and components designed to handle the wear and tear. Along with an increased resistance to deterioration, these high-quality parts also extend the lifespan of commercial screens far beyond that of consumer models, something that is critically important when one considers the difference in operating hours between the two.

Consumer screens in people's homes are turned on anywhere from one to eight hours a day, and serious TV watchers or gamers may even have them on for 12 or more. But, many deployers demand 12-15 hour days out of their screens and locations like airports may never turn the screens off.

Commercial screen models are now being designed specifically for extended-use applications and some also include features such as enhanced burn-in protection and cooling mechanisms.

To accommodate the numerous types of network connections and media playing devices that may be used, commercial grade screens have PC inputs, serial ports, Legacy and VGA inputs.

Knowing the difference

Commercial

- Designed for 24/7 use
- Can be used in portrait or landscape mode
- Enhanced bezels for toughness and cooling
- The right choice for digital signage deployments

Consumer

- Manufacturer's warranty limited if used for digital signage applications
- Only connect to DVD players and cable
- Shorter lifespan than commercial grade
- Fancy bezels don't allow for proper cooling

4. Warranties

Since manufacturers build commercial grade screens to last, they also stand behind the production quality of those screens. Many of the top-grade manufacturers will do so by offering a more robust warranty program for their lines of commercial grade screens than they do for consumer grade models.

"Consumer products have a standard one year warranty and usually specify within the documentation that use over and beyond four to six hours a day will void the warranty," said Brian Slowleigh, an account manager who has worked with technology companies including Microsoft, HP and NEC Display Solutions. "True commercial units will have a three year warranty that covers landscape and portrait installations."

5. The extras — glass, clocks, air-conditioners… and the list goes on

Lastly, like a luxury car, commercial-grade screens provide users with some amenities that make them a clear choice for digital signage.

"Some commercial-grade screens have built in clocks and timers to allow the user to ensure the unit is turned off during non-performance," White said. This benefit also allows users to know that the screen is on, something that is critical for proof-of-play reporting of signage content. Since all applications are different, commercial grade screens can also be used in both portrait and landscape modes, while consumer grade screens are strictly landscape.

The screen itself is also a factor, with commercial grade screens often touting enhanced glass modules designed for long hours of operation and that are less sensitive to image retention issues.

"True commercial models use a commercial grade glass that has multiple layers allowing for 7/24/365 operation cycles," Slowleigh said.

Lastly, cooling systems have become key selling points found on many commercial grade screens.

"Consumer products use fancy plastic bezels and encasements that don't allow for proper cooling of internal electronics," Slowleigh said. "Commercial models will have full ventilation and/or cooling fans to maintain a consistent temperature for longer life. Heat is the number one cause of 'tiger-striping' or mura in LCD technology and once it's occurred, the units are permanently damaged."

Top five reasons to go commercial

1. The enclosures
2. Inputs
3. Heavy-duty hardware means a longer lifespan
4. Warranties
5. The extras – Glass, clocks, air-conditioners…and the list goes on.

LED-backlit screens have moved into the mainstream and are poised to take the lead when it comes to digital signage in the commercial space.

LED backlighting

For most of their history, the LCD screens used for digital signage have worked like this: A panel of cold cathode fluorescent light (CCFL) tubes, not unlike those used in office buildings, is placed behind two panels of glass filled with liquid crystal matter. When turned on, the CCFLs illuminate the image and it can be seen by the viewer.

But that has changed. LED-backlit screens have moved into the mainstream and are poised to take the lead when it comes to digital signage in the commercial space. Commercial-grade LED-backlit screens use either a matrix of light-emitting diodes (LEDs) behind the screen or, more recently, an array of side-mounted LEDs to replace the CCFLs. Although the concept is generally the same as CCFL backlighting, the differences in performance are significant.

According to the DisplaySearch Quarterly Large-Area TFT LCD Shipment – Advanced LED Report, in the first quarter of 2010 CCFL displays accounted for virtually all of the commercial displays sold. By the end of 2011 that number had fallen to 84 percent while LED backlit display shipments accounted for 16 percent of the commercial displays shipped.

Those trends are expected to continue, with the number of commercial LED-backlit displays sold expected to overtake CCFL-backlit displays within the next few years, with CCFL displays expected to eventually disappear entirely.

Many of those differences between LED and CCFL backlighting can be summed up in one word: clean.

LED-illuminated monitors can produce a significantly better dynamic contrast ration compared to most standard CCFL-illuminated displays, and a better contrast ratio.

Clean image quality

Most people who view an LED-backlit screen agree that the image displayed is brighter and cleaner than a CCFL-illuminated display. While it's difficult to quantify what creates that perception, the answer may lie in the improved contrast ratio offered by an LED-backlit display.

LED illuminated monitors can produce a significantly better dynamic contrast ratio compared to most standard CCFL illuminated displays. They can produce deeper and more saturated blacks when the LEDs are in their off state and more "pure" or accurate whites when they are in their on state.

LEDs are inherently able to be switched on and off more quickly than CCFL displays and typically can offer a higher light output. And in most designs, the LEDs are able to illuminate specific areas on the display depending

upon the requirements of the input signals. This permits more brightness concentration where it is needed and ends up in providing a better contrast ratio in the process.

Environmentally clean

While no electronic appliance is entirely environmentally friendly, LED-backlit LCD displays are a big step in the right direction.

The major direct benefit is the elimination of mercury, a component of CCFL lighting. Due to health and environmental concerns about mercury, it is illegal to dispose of fluorescent bulbs in landfills in California, Minnesota, Ohio, Illinois, Indiana, Michigan and Wisconsin.

But LED backlighting offers a number of indirect environmental benefits as well.

Depending upon the design and screen size of the LED illuminated display, they can achieve up to a 50 percent savings in energy. While not a major issue in a single consumer display, in commercial multiple display applications and 24/7/365 operation, the savings can be significant.

The lifespan of an LED backlit panel can be nearly twice as long as that of an LCD monitor with a CCFL backlight, meaning fewer panels headed for the landfill at the end of their life. The typical lifespan of an LED backlit panel is in excess of 100,000 hours versus 60,000 hours for an LCD monitor with a CCFL backlight.

In addition, the LED backlight units in an edge-lit display are on the edge of the panel, away from most of the other circuitry not close to any of the components. Because of that and the fact that the LEDs generate less heat, it is much easier to keep the units cool.

Challenges

There are some challenges to LED-based displays, however, including cost and lifespan.

The price of LED displays is expected to drop, but currently, they are more expensive than those lit by CCFLs. Industry analysts do not expect the cost of LED displays to come down until at least 2013.

At the same time, the lifespan of an LED panel is shorter than that of a CCFL. LED-backlit displays last between 35,000 to 40,000 hours, while CCFL-backlit displays last 60,000 hours.

Benefits of LED-backlit Displays

- Elimination of mercury
- Energy savings
- Cleaner image quality

CHAPTER 2

Media players

When designing a digital signage network, deployers are invariably faced with the question of which is the best choice to drive the display, a commercial PC, a PC-based media player or a non-PC-based media player.

The answer? It all depends, experts say.

PCs and PC-based media players are based on the same X86 architecture, the same processors, memory, storage, graphics chipsets and so forth. The main difference is that one is built specifically for use with digital signage while the other is built for more general applications. On the other hand, a non-PC-based player typically uses specialized processors and software that may limit its capabilities.

There are pros and cons to all sides when choosing between a PC, a PC-based media player or a dedicated media player for a digital signage deployment.

"There are a lot of different factors that would have to fall into place for someone to make a determination," said Brad Fairman, vice president of Burlington, Ontario-based digital signage provider AVI. "How long is the unit going to be running? Is it going to use any specialty software? What is your budget?"

It also depends on the type of PC or media player being used. A general purpose commercial PC can be less expensive than a built-for-purpose PC-based media player, while a non-PC set-top type box can be less expensive than some types of PCs.

Here is a look at some of the issues to consider when it comes to choosing between a PC, a PC-based media player and a non-PC media player for a digital signage deployment:

Cost, flexibility and size

Dedicated media players generally come in a variety of price points and performance levels. An entry-level media player is usually made to run content to one screen at a time, while higher-level players are capable of running multiple messages in multiple screens.

Major types of digital signage players

Devices for digital signage playback utilize a variety of different technologies and form factors, but can be broken down as follows:

PC-Based Players generally use an "X86" architecture based on the same Intel or AMD processors and chipsets found in general-use PCs.

Non-PC Players use technologies based on specialized processors and chips found commonly in devices such as DVRs and digital TV boxes. Increasingly ARM-based devices are emerging as another alternative. ARM is popularly used in smartphones and tablets.

While non-PC players are inexpensive and reliable, they are generally less able to play complex content due to the low-power processors used in the hardware. They are also generally available from vendors only with software burned into the unit's firmware, so they cannot be made to run a variety of software applications.

PC-based players offer more power to allow broader software options and various types of complex content. They also offer greater versatility by being based on common standards. A digital signage operator can choose from a variety of software and hardware choices at various price points and can "mix and match" hardware and software to meet project and IT requirements.

PC-based media players tend to be slightly more expensive than a PC, mainly because PCs are produced on a much wider scale. Non-PC-based media players may be the least expensive option, although their options for the types of content they may be able to play and their scalability may be limited.

Mass-market commercial PCs generally offer more options for processors, storage and memory at a lower cost and with a better warranty. On the other hand, commercial units may lack HDMI and serial ports required for a digital signage deployment, which may result in a need to use adapters, which adds slightly to the overall cost.

While a lower price is a plus, size and flexibility are also important considerations.

PCs and PC-based systems use Windows, a standard program that works the same across PCs. Proprietary non-Windows software is unique to one company and that company's hardware.

On the other hand, while PCs may carry a slight edge in terms of flexibility, standard versions of Windows aren't tailored to run a digital signage project so there may a lot of overhead and bloat that may not be evident in a dedi-

PC-based systems run on Windows, while proprietary software is unique to one company and that company's hardware. Because Windows works the same across all PCs, deployers have more flexibility.

HP media players pair with digital signage displays to engage customers

Hewlett-Packard media players are meant to help retailers and hospitality businesses engage customers through interactive digital experiences.

Using Intel core processor and high-definition graphics, the HP MP6 can power digital mall or hotel directories, the company said in a news release, while also engaging shoppers in an interactive brand experience when paired with a touch-enabled screen.

And the HP MP4, the company's thinnest player, is geared toward common signage implementations in retail or hospitality settings. The HP MP4 can display brand-related content through static images or full-screen videos to improve the store experience. It features a 64-bit AMD processor with Radeon HD 6320 graphics.

"Retailers want to incorporate innovative technologies to inform, engage and attract customers to their stores, but many still struggle with the complexity or cost," Ray Carlin, HP vice president and general manager, Retail Solutions, said in the release. "HP's new media players and its full portfolio of signage solutions mean retailers of any size will be able to deploy affordable and compelling in-store signage."

The company said the players will help retailers facilitate an omnichannel experience for online shoppers who enjoy browsing items or otherwise interacting with a store's brand — for example, by including a digital screen in the store that allows shoppers to access a wish list they created online.

Both media players feature a streamlined Windows Embedded operating system and can be mounted on the back of a digital screen to maximize space.

Pricing information is available from HP resellers.

cated PC-based media player. Although a PC may be high-performance, much of that performance may end up being utilized by resources that aren't necessary for operating the digital signage network.

The solution to that situation is through the use of Windows Embedded, which can be streamlined and tailored to the task of digital signage playing.

Components for commercial PCs and PC-based media players are typically available from multiple suppliers around the world, while components for non-PC-based players may only be available from a limited number of suppliers. An equipment breakdown could resulted in extended downtime while waiting for parts or repair.

Non-PC-based media players can be small enough to be mounted behind the screen itself while off-the-shelf PCs are often bulky and require additional storage space. In a public space, such space can be extremely costly or not available at all. Recent innovations in PC board and form factor design, however, means that high-powered PCs are smaller than ever and able to be mounted behind the display.

CHAPTER 3

Connectivity

Today, the vast majority of digital signage deployments are networked. The advantages of a networked digital signage system are far greater than simply the cost savings; such systems also add value by their ability to update content, nearly in real time, and increase its relevance to the viewing audience.

The days of updating signs by flash drives and other manual, non-networked approaches have simply become a thing of the past. Having a network means a deployer will always have the highest level of control on their digital signage deployments, no matter how big those deployments might be. Whether the display is next door or on the other side of the world, they will always know what's going on with that display.

A network enables digital displays to send and receive data to and from a central point of control, typically managed by the network operator or administrator. Most networks today, by and large, are Internet Protocol-based, or "IP"-based, networks — meaning that each display is given its own unique IP address and uses the Internet as its primary means of communication.

Types of networks

Physical network connections take many forms. "Cabled" or "hardwired" networks link displays together through a series of Ethernet cables, switches and routers. Several different types of wireless networks use technologies such as satellites, Wi-Fi and cellular communications.

Hardwired Ethernet networks, Wi-Fi networks, and in some cases satellite networks provide the benefit of a persistent, typically higher-bandwidth connection. This enables digital displays operating "streaming" of content to displays, thus providing "live" video capabilities.

Cellular-based networks

Cellular networks, also known as wireless broadband, data services, or simply 3G/4G networks, have become more commonplace in the market over the past several years. Cellular data services are provided by carriers

Having a network means a deployer will always have the highest level of control on their digital signage deployments, no matter how big those deployments might be.

Connection technology

- Ethernet cables
- Satellites
- Wi-Fi
- Cellular communication

such as AT&T, Sprint, Verizon Wireless and TELUS (in Canada) and deliver broadband Internet access though the carrier's existing network.

By integrating cellular modems and data services into digital signage displays and media players, network operators gain anytime, anywhere Internet access without the need to connect to a hard-wired local area network or Wi-Fi access point.

Cellular networking can be deployed in a number of configurations. A data services modem, for example, can be used to connect each media player directly to the cellular network, while a cell-to-WiFi device can be used to create a virtual Wi-Fi access point for up to five media-players equipped with Wi-Fi adapters each of which drives an individual displays. This is particularly desirable in situations where a group of displays are in close proximity, and financially advantageous in that only a single monthly cellular data service fee is required.

All major North American carriers, including AT&T, Sprint, Telus, Verizon Wireless, and T-Mobile now offer 3G cellular broadband services. Many of these companies are also investing in the next-generation 4G cellular broadband network, whether it's Sprint's 4G-based WiMax network or Alcatel-Lucent's 4G/LTE (Long Term Evolution) network technology begin considered by Verizon Wireless and others.

Industry experts say4G networking will be a dramatic game-changer in the world of digital signage, serving as the tipping point for cellular-based digital signage deployments. It has the horsepower that network operators need for their rich and relevant content, especially video, but with none of today's wired and IT issues.

By integrating cellular modems and data services into digital signage displays and media players, network operators gain anytime, anywhere Internet access without the need to connect to a hardwired local area network or Wi-Fi access point.

CHAPTER 4

Installation and Mounting

When employed properly, digital signage can deliver highly targeted ads to audiences, providing a greater return on investment than more traditional ads. However, if not planned properly, an installation can cost businesses more money than originally planned.

Here are some considerations when planning a digital signage deployment:

Screen placement

Proper placement of screens is a vital part of a successful digital signage network. Screens should be in a location where customers will see them without obstructions, and they should be near the products they're selling.

But, placing digital signage is not that simple. A poorly placed screen can mean its message is lost.

Hiring a professional site survey team might cost more up front, but doing so can mean a greater return on the deployer's investment. The team can give suggestions as to proper placement and settings of a digital signage network.

When placing a screen, consider visibility, the power source, wall type and the surrounding environment.

Visibility: If a customer can't see the screen, the digital signage won't be effective. While that seems obvious, there is more to visibility than meets the eye.

"There might be window glare or light glare or glare from other units, and all of those things need to be countered," said Mike Litteral, who works in the technical department of Oakland, Calif.-based Lucasey Manufacturing Corp., a provider of mounting solutions for digital signage.

Power. Once the screens are in place, they'll need to be connected to a power source. If there isn't a power source nearby, one will need to be installed, which creates an additional expense.

Considerations when placing a screen

- Visibility
- Power source
- Wall type
- Surrounding environment

"It sounds like it's pretty easy, but people often fail to consider the electrical portion," said Tim O'Connor, professional services sales manager for the National Service Center, a digital signage installer based in Greenville, S.C.

Wall type. When mounting the digital signage, the type of wall holding the hardware needs to be considered. What type of wall will the screen be attached to? How sturdy is the wall? Will metal studs be hit when drilling begins?

Once the holes are drilled, the proper mounts must be installed, ideally ones that allow for a 15- to 25-degree angle to improve visibility for customers.

Environment. Location is important, but so is the environment around the screen. Heat damages plasma screens, so the screens cannot be placed in any area where the temperature will exceed 90 degrees Fahrenheit. Plasma screens utilize small cells containing electrically charged ionized gases, similar to fluorescent lamps. Extreme variations in temperature also can have an impact on screen performance.

"A screen might need some type of weatherization so it can withstand the environment in Florida, California, Wyoming, Denver or wherever it happens to be," Litteral said.

Cabling

Delivering content from the media player to the screen often requires cabling. However, business often underestimate the amount of cabling they need.

"The cost of adding the necessary cabling and A/V transport devices is often overlooked in the planning phases," said Matt Schmitt, CEO of Dallas-based Reflect Systems, a digital signage provider.

The amount of cabling required depends on where the media player is placed. To keep media players safe, many deployers place them in back rooms, a sizable distance from the screens.

Such a placement requires extensive cabling or an extender, which allows for greater separation between the media player and the screen by allowing the signal to be transmitted over a greater distance.

If the transmission distance is more than 300 feet, the different twist rates of the wires in a CATx cable start to cause video color split on the display, degrading the quality of the video signal. And splitting a signal for use with multiple screens can cause further video degradation if not implemented correctly.

ossmann

The amount of cabling depends on where the media player is placed, and the costs can quickly mount.

Digital signage video-transmission systems tend to have two styles of receiver units: those with de-skew and those without de-skew. For distances between 300 feet and 1000 feet, the deployer will need a transmission system that supports de-skew.

“Extenders that have a skew adjustment can correct cable-induced video timing errors on long CATx connections,” said Heather Santos, marketing manager with Newburyport, Mass.-based Adder Corp., a provider of switches and extenders for IT systems. “In installations with a large distance from the media player to the screen, a transmission system (extender) that supports de-skew is usually necessary.”

Long cable runs also need to be secured properly to avoid any potential liability issues, further adding to the cost of the deployment.

Physical installation

Although it may be tempting to try a do-it-yourself installation, there are several variables that make choosing a professional installer a better choice.

Weight. Often, a screen may look light enough to be lifted single-handedly. Screens can be deceptively heavy, however, and do-it-yourself installation can result in injury, either to the person or the screen. A professional installation team will be able to safely lift the screen.

Restricted access. Screens need to be easily visible to customers, but not accessible to them. When customers have access to a screen, it leaves the signage vulnerable to damage. Whether intentionally or unintentionally, customers who have access to the screen can damage the hardware, cause the screen to fall from its mount or disrupt content.

A site survey team can advise on the safest, most effective places to install the screens, while a professional installation team can ensure the screens are properly secured.

“We have mounts where you could do a video wall and the screen would come directly forward or retract directly back,” Litteral said. “It requires a special tool to allow the mount to advance, but anyone walking by couldn’t move it because they wouldn’t have the tool.”

There are other, seemingly minor, issues that can quickly add to the digital signage price tag. Drilling into a wall to mount the screen, for example, can cause drywall, insulation or acoustic tiles to fall, creating a mess that must be cleaned.

Because there are so many things to account for in an installation, deployers often make costly mistakes despite the best of intentions.

“All of the different options can be confusing,” O’Connor said. “There are so many that they can overwhelm someone.”

About the sponsor:

Hewlett-Packard Company

HP Digital Signage Solutions provide information in an attractive format that entertains, informs and engages for a unique experience that gets results. HP, along with the company’s industry leading partners, can supply and deploy a complete solution to meet a company’s business needs with a comprehensive digital signage solutions portfolio. HP has worked with its partners to provide certified hardware configurations optimized for smooth and reliable operation.

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