SKYKIT®

Digital Signage Guide

10 Digital Signage Topics You Need to Know Before Buying

5

Digital Signage Hardware: What to Look for

Sales

sales@skykit.com

Phone

Toll Free: 855.383.4518

Local: 612.26a0.7327

Address

420 N 5th Street

Minneapolis, MN 55401

www.skykit.com

Digital Signage Hardware: What to Look For

Digital signage hardware forms a crucial part of the holistic solution, but customer sometimes shop brand or price only unless the project is of significant size. And in today's market there is much confusion around the difference between using a consumer TV versus a commercial display.

Selecting the right hardware is just as important as selecting the right CMS software can be, and should be just as carefully chosen to suit a particular use.

It's easy to focus on software or on content since those can be a little more "sexy."

The truth is, you need to focus on all parts of the digital signage rollout in order to get not only a cohesive solution, but a scalable, secure network.

Each digital signage system needs three major hardware components:

- **Media Player:** The media player is the "brains" of your digital signage. The media player is what pushes your content to the screen (one media player per screen unless a splitter is used to drive multiple screens from one player).
- **TV or Display:** You definitely know this one. It's where your content shows up. Sometimes, the media player and the screen are integrated, with the player hidden inside the screen's casing. Small business may get away with a consumer grade TVs for their display, but consumer displays are meant for approx 6 hours of play per day, typically have a one year warranty, have limited functionality, and are meant for landscape use. Commercial grade displays come in three basic types: LCD, LED or OLED.

1. LCD - LCD displays are generally less expensive, wider in depth and weigh more than LED displays. LCD displays have been the most widely used type of display for signage until recently **NOTE: LCDs offer a preferred long-life, high-performance, cost-effective solution, while the benefits of OLED may be best suited to deliver the "wow factor" of very high profile or architectural media.**
2. LED - Increasingly more popular, due to performance and economies of LED panels that are back-lit, edge-lit and direct-lit. LED types use either a matrix of LEDs behind the screen or an array of side-mounted LEDs to replace the cold cathode fluorescent light lamps of LCD. Although the concept is generally the same as back-lighting back-lighting, **LED displays offer a sharper, clearer image and offer brighter colors and better contrast over LCD. LEDs also offer lower operating costs by using up to 50 percent less power consumption than**

CCFLs. LEDs offer a slimmer profile, with some commercial displays being less than a few millimeters in depth versus up to 5 inches with CCFL displays.

3. OLED - organic light-emitting diode (OLED) OLED technology is emerging as an advanced flat-panel display option. These flexible, bright, ultra-thin, highly energy efficient displays are similar to a regular LED, except that they are made up of organic semiconductor material sandwiched between two electrodes that produce light when a current is made to flow through its volume.

- **Mounting:** Your screen needs something to hold it up, and that's where mounting comes in. There's many types, from simple wall and ceiling mounts to floor stands. I'm also going to include stands and kiosks in this category.

In this chapter, we'll compare different types of hardware in each of these three categories.

Once you understand your options, and a framework for how to approach this, you'll find it much easier to select hardware that's right for your project.

I made a free guide for you that will help you put these strategies into action when you're evaluating digital signage hardware.

The PDF outlines — step-by-step — exactly what questions to ask and how to approach hardware using the concepts I talk about in this post… you can bookmark it, print out, or keep it in a folder for reference. Get your PDF here.

Understanding Your Media Player Options

When designing digital signage, people tend to go for the things that look good from a user interface perspective, like the Content Management System (CMS).

And it's vital to have a good CMS.

But the best CMS in the world is worthless if the players fail to deliver your message to the targeted audience. In the end, selection of a digital signage solution is a balance across all components with respect to the solution requirements.

The Industry

The digital media player industry is still young, and still evolving. You may remember from Chapter 1 that digital signage itself was born alongside media players.

Since those early days, the industry has boomed. Most major electronics manufacturers offer media player options, as do several large digital signage companies.

Even Google's getting in on the digital signage game, with partnerships with a number of different OEMs to build Chromeboxes, Chromebits, and Chromebases based on Chrome OS (discussed lightly below and in more depth in Chapter 7).

There's an option for every use case and budget, for SMBs to enterprises.

Distinguishing the players from each other are factors like size, processing power, manageability, commercial setting-friendly components, memory, storage, price, and more.

The Categories

Media players can be loosely grouped into a few categories.

Since there's such a glut of options on the market, knowing what general category you're interested can be your first step in narrowing down your choices.

Each category will contain some options that are designed for use with digital signage, and some options that aren't specifically created for digital signage but can work to power it anyway.

We'll run through each, giving use cases and examples along the way.

There's another grouping that overlaps with these categories, so I'll address it separately here.

Proprietary media players are ones designed by and/or built for a particular digital signage company.

Hypothetically, they could show up in any of the below categories.

Their main advantage is that they're optimized to work within a digital signage environment created by that brand—no worries about compatibility whatsoever.

Boxes

Box-type media players are, in essence, small form-factor computers—usually about 5x7". They were the first type of digital media player built for digital signage.

They run on a variety of operating systems: Chrome, Mac, and Windows, primarily. Some are designed specifically for digital signage, and some are meant as home computers but repurposed for digital signage.

Worth highlighting here as an example are Chromeboxes. Born in 2012 they're small form-factor computer boxes that run on Chrome's OS.

The idea is that you can set the box on your desk, plug in a monitor, mouse, and keyboard, and set up your own little desktop computer… or skip the mouse and keyboard and have a digital sign.

With a low price point and the ability to enroll in Google's powerful Chrome Management Console, they're an increasingly popular option.

Chrome itself doesn't make these devices; rather, there are numerous models on offer from OEM's like HP, Asus, Acer, and more. They're differentiated by their size, materials, processors, RAM, and other factors. AOPEN offers Chromeboxes specifically meant for signage. (Skip to Chapter 7 to learn a lot more about Chromeboxes.)

Box-type media players offer some advantages. For one thing, they're super flexible in terms of how they can be set up and networked with other devices and accessories. And there are many, many options on the market for many needs.

On the downside, boxes range from about $150 for some Chromeboxes to well over $800 apiece. Those heavily optimized for commercial settings and high-end performance will be more expensive, of course, and you'll need to buy the screen separately.

Also, you'll have to hide the box somehow.

Use cases include… Well, just about any digital signage application imaginable. But for just a few, think about giant, tiled video walls; wayfinding systems; POS advertising and self-checkout systems; front desk information hubs at schools; interactive changing rooms at department stores (check out Chapter 10 for other futuristic ideas); and much much more.

Sticks

Stick media players are similar to the box type, but shrunk down even smaller and plugged directly into the screen.

They typically have fewer peripheral ports and less-powerful processors than box players do.

It can be a little confusing looking at stick media players, because there's some very similar devices that might also be marketed as digital signage tools, but aren't truly media players.

To exemplify the difference, let's look at two devices from Google: the Chromebit and the Chromecast.

Streaming Devices vs. Media Players

Chromecast, born in 2013, is a **media-streaming device** that plugs into the HDMI port of a screen, allowing the user to stream content. The device is small and is shaped like a mini hockey puck.

After you plug it into your HDMI port and connect to a Wi-Fi network. It acts as a portal for the content on your computer or smartphone to be played on your display. It also includes apps such as Netflix which let you stream content to the display.

The Chromecast, as its name implies, is intended to *"cast" content from one*

location such as a computer, tablet or smartphone, onto a display. You'd need a dedicated laptop or computer for each and every Chromecast.

The Chromecast is not a media player. *It depends on another device to act as the media player* and simply acts as a link between that device and the screen. *It cannot be managed with CMS.*

Now contrast that to the **Chromebit**, which is a *true stick-type media player.*

Chromebit, born in 2015, is a small device that runs on Google's Chrome OS operating system. The stick-like device closely resembles a thumb drive.

Chromebit, when plugged into the HDMI port of a monitor, acts like a tiny personal computer, with access to the Internet and Google's browser-based apps.

The Chromebit is seemingly similar to the **Chromecast**, but in fact, **it is in a completely different class of machines**—it IS a general purpose computing tool.

The Chromebit is functionally equivalent to a Chromebook, without the display.

So you can think of it as a $85 computer on a stick. The Chromebit is more functionality aligned with a Google Chromebox, with the same performance capabilities, but without the ethernet port or multiple peripheral ports. It allows the user to add a Bluetooth keyboard or mouse.

Vitally: It also allows the *device's settings to be managed* with Chrome Management Console, and *its content to be managed with a CMS.*

Because of this, the Chromebit provides more functional capabilities, complexity and flexibility than the Chromecast.

More About Stick Media Players

Stick media players often run on lightweight operating systems like Chrome OS or Android. Lightweight isn't necessarily a negative: most also have less powerful processors (think a 1.8GHz Rockchip) than box media players have, and an OS that isn't resource-intensive will run much more speedily.

They should be able to play anything up to HD video with ease, though they may struggle with 4K video or zoned video.

One attractive factor is the price point. Chromebits are a mere $85 per unit, which is about half the price of a very basic Chromebox.

Also appealing are the tiny size and low power demands.

However, stick media players are generally not considered enterprise grade solutions. Most are primarily made of plastic and don't have long warranty options. They won't be as durable in a commercial environment as an optimized box player.

Many won't be able to handle more obscure file types or complex applications.

Use cases include classroom signage; lobby signage; safety training and enforcement in QSR and other settings; and advertising-centered signage at businesses, especially at SMBs.

All-In-One

All-in-one media players are a newcomer even in this young industry, and they excite many people who appreciate convenience and streamlined systems.

With all-in-one media players, the media player is integrated with the screen.

There's a couple different ways to do that.

A small box-type media player can be mounted behind or within the casing of the screen. This can lead to bulkiness, or cause the screen to stick out far beyond its mounting.

As an example: In Chapter 7, we briefly talk about Lenovo's Tiny-in-One solution, which allows you to take one of their ThinkCentre Chromebox Tiny devices and install it in a screen's casing.

Or, the display can make use of System-on-Chip technology. That's right: the media player is condensed down to a chip and built into the screen. This allows the screens to be much slimmer.

All-in-One players are appealing due to the price point and convenience. You (typically) don't have to buy the screen and player separately. Plus, setup couldn't be easier. Just plug it in and connect to WiFi or Ethernet.

The downside: Decreased flexibility. There aren't as many options in terms of size and screen type as when you're mixing and matching media players and screens separately.

You'll have a difficult time upgrading memory or storage, or even troubleshooting issues, with the media player hidden away in the screen. And with a SoC, if either the screen or the media player dies, the whole thing will need replacing.

Plus, there's just not as much you can do with them—you'll have a tough time setting up a complicated video wall or touch-based payment system with a SoC or other all-in-one player, especially one not optimized for commercial settings.

It can be done, though: pop over to Chapter 7 to see how a fish restaurant gave the franchise a facelift using Chromebases.

Use cases include wayfinding at malls, schools, and medical facilities; sign-up kiosks at businesses; POS systems; teleconference-enabled conference room signage; and more.

Which One is Best: A Quick Comparison

Especially at the enterprise level, *there are many players on the market for digital signage.*

We wanted to review some of the more popular devices within the most common categories: Chrome-based, PC-based (Mac/Windows), embedded within a display, and proprietary.

And here's what we picked to represent those categories:

Blackbox iCompel and Cisco Edge (proprietary), LG 55LX (embedded within a TV/Display), Mac Mini and Dell Precision (Mac and Windows PC, respectively), and Asus' Chromebox and Chromebit (Chrome-based).

The review focuses on the device attributes needed for an *effective, secure, scalable solution.*

How'd they measure up? Read on to find out!

Comparisons

Natively Secure Operating System

Is the operating system **inherently or "natively" secure**?

This goes to the design methodology and approach to how the operating system is maintained and updated.

Chrome OS wins hands down in terms of known issues (absolutely none!), rapidity and approach to patching and updating (all automatically controlled by Google).

Google designed the commercial version of Chrome OS to be enterprise-grade by providing the capabilities needed by large organizations in terms of security, scalability and maintainability.

Security

The above "Natively Secure" category is more about the mindset of how the operating system is developed and maintained, but also drives this Security Category.

Chrome and the Chrome Device Management (CDM) Console win again, for the reasons mentioned under Chromebox Pros above.

Operating System Support for Kiosk Mode

By "Kiosk Mode," we mean:

Can the device be configured from an administrative perspective to boot into the digital signage application—and only the digital signage application—protecting it from misuse for other applications?

Chrome OS wins from a general purpose computing device perspective over Windows/Mac. As for the proprietary units, they come in a three-way tie for first as they are dedicated digital signage devices.

Resolution

Display resolution (and screen size) will always get better.

1080p is today's norm and 4k is already making inroads.

> **It's important that the player be able to play in a resolution appropriate for general purpose digital signage applications across the wide variety of available displays, and *right now* that means 1080p.**

The Mac wins here as it already natively supports both 1080p and 4k in the base unit.

CPU / Processing Capability

All of the players implement CPU/GPU combinations enabling them to successfully support complex content requirements – full motion video and animation, crisp and clear.

Included Connectivity

The Chromebox and Mac Mini tie for the win here as they both provide WiFi, Bluetooth and Ethernet connectivity in their base unit.

The Chromebit is hindered by its small size and therefore does not provide an ethernet port but **it does also include Bluetooth** where the remaining devices do not. On the downside there is no clock, which can cause problems if the sign loses internet connection and can't reboot it's playlist schedule correctly.

All of the other units either require an upgraded version to support WiFi or in the case of the embedded display, do not support WiFi connectivity.

All of the reviewed devices provide USB connectivity.

Device / Player Management

Scaling the maintenance and management process means being able to support many players easily.

In other words, it's what keeps your digital signage from becoming a massive headache.

This is another category where *Chrome devices win* across the board.

The Chrome Management Console provided by Google means that you can remotely manage one device through policy management and those policies can automatically be pushed to thousands of devices.

There's not a limit to how many you can include.

Statistics on player operation, remote reset, remote screenshots, it's all there.

Cisco is a close second because of its robust network management lineage.

Green Tech

Do the reviewed devices represent an opportunity to reduce power utilization as a result of how they are built?

Just measuring the size of the included power supplies makes it easy to assess. Cisco, the Black Box, and the Chrome devices are the most green.

Form Factor

How easy is it to physically hide the player/device?

Form factor helps to determine and can limit the aesthetics of your sign.

Ever see a really high-end digital sign on an expensive, impressive stand with a large tower computer standing next to it? It kind of ruins the brand impression.

Smaller is better and from that perspective the *Chromebit cannot be beaten* as it can fit easily in a pocket.

Next best are the Mac Mini and the Chromebox.

Price Point

There is a 10:1 difference between the least and most expensive devices reviewed.

However, *price shouldn't be your sole deciding factor*. In fact, it can be like comparing apples to oranges.

A SMB-friendly solution like a Chromebit will naturally be far less expensive than a top-of-the-line commercial media player box meant for enterprise use.

Understand what features are important to your use case first, and then look at the price of options that offer those features.

Chrome represents the least expensive of the reviewed solutions and leads at that price point from a feature/function comparison too.

What's Your Goal?

All of these reviewed devices are effective digital signage media players.

Some have been around awhile, others are new to the market. Some are dedicated to digital signage, others are general purpose computing devices cast into application-specific roles.

Evaluate your solution from the perspective of your unique application requirements, and your organization's ability to support the player devices themselves.

Here are some questions to consider when making your purchase:

- Are you deploying one or hundreds/thousands of devices?
- Where do you spend most of the time managing the player/device itself? Is it the operating system of the player (patching, etc.) or more digital signage application-focused?
- How easily and well does this player management process integrate with the digital signage application?
- How does the player management process integrate with your existing support infrastructure?
- Can you control the display (e.g. input) remotely through the player or do you have to be physically at the display with a remote control?
- Can the player use standard off-the-shelf components to enhance its capabilities or are they proprietary?
- How powerful a processor will you need, based on what type of content you'll be playing? Players with more powerful processors frequently cost more, so choose appropriately.
  - 1.8GHz Rockchip: A lightweight processor of the sort found in Chromebits. Good for simple content.
  - Intel Celeron: Good for standard digital signage content, and WiFi and Wired networking.
  - Intel Core i3/i7: The heavy hitter, which can play 4k video, streaming video, multi-zoned video, and more.

If you're deploying 1,500 digital signs, you don't want 1,500 IT problems.

Which device works best for your digital signage deployment? Can you do better for the given cost?

Chrome-based devices, given their price point, operating cost and remote management/support capabilities, are very hard to beat as general purpose digital signage players, be it a one-unit deployment or a network of thousands of digital signs.

Displays

When it comes to screens, there's a surprising number of options available, each with its own strengths and weaknesses. Here's a quick breakdown.

LCD

LCD screens are a digital signage workhorse[74].

More affordable than LED screens, lighter than plasma screens, and available in sizes up to 95" and with resolutions up to 4K, they're versatile.

If you're going to have a digital sign where viewers will be up close and personal, you probably want to go with an LCD screen.

However, they are limited in their brightness output, contrast, and viewing angles.

Bear in mind, too, that the protective glass layer on the LCD screen is quite reflective and can create a mirror effect. This can be an issue in certain lighting conditions, making the content hard to read.

It is important to note that if you use fluorescent lights, most companies use specific cases for their screens to counteract light, dust, and vandalism.

LED

Light-emitting diode (LED) screens are a popular option for numerous applications.

Where these incredibly bright signs were primarily used outdoors at large sporting events or other venues, the screens are now popping up indoors as a big trend.

There are a variety of reasons for that.

- Because LED is flexible, it can adhere to any screen ratio or size, flexing around pillars or other unusual shapes. For very large screens, it's a great option.
- There are some advantages[75] to using a high-resolution LED display compared to a projection or liquid crystal display (LCD) in large video wall-type applications. LED can display superior images without bezel distraction or ambient light adjustment.
- Because LED's don't wash out colors like fluorescent lights do, this makes the LED option perfect for indoor displays and retail applications. This is good news for retailers, especially now that LED offers incredibly rich colors.
- Contrast levels have improved too, thanks to the ability to dim individual LEDs to lower light output levels.Having said all of this, LED may not always match the precise Pantone of your artwork, so is probably not the best use for food service.

OLED

OLED stands for Organic light-emitting diode[76]. These contain thin flexible sheets of an organic electroluminescent material, and are used for visual displays.

This fancy newcomer offers infinite contrast (since individual pixels can be turned on and off), potentially very high resolutions, low weight, and high energy efficiency.

Because they don't require a backlight, they're incredibly thin.

However, for now, they're relatively expensive—as the technology develops, costs will go down.

Projection

A projected display is appealing for many reasons.

A single projector will be much less expensive[77] than a very large screen or video wall. (Not to mention seamless!) They also have a high brightness output: up to 50K lumens. High resolution options exist.

The main drawbacks: Limited interactivity and the need for a flat, white projection surface.

Plus, they need to adjust to ambient light to produce a perfect image.

Which Is Right For Me?

While I'd say LCD is probably the best all-around choice, there's no one-size-fits-all solution.

It's all about what works best for *you*.

And, in fact, type of screen is far from the only factor at play. Below are some others to consider.

A quick note:
Many OEMs focus on different verticals, making screens specialized for particular environments.

For example, one meant to be used at an outdoor bus stop would have sturdy gorilla glass to prevent vandalism, high heat tolerance, and extra brightness to counteract the ambient light.

Because there are hundreds of options out there, it may be best to simply ask a trusted partner to recommend one to you.

The questions we discuss below will help you define your needs more accurately to that partner.

Indoor, Semi-Outdoor, or Outdoor?

As we mentioned in Chapter 1, **indoor, semi-outdoor, and outdoor screens** are very different from one another, each with special technology specific to its intended environment.

Indoor screens might have dust-repellent encasing, a scratch-proof screen, and a robust cooling system. However, the screen wouldn't need to be quite as sturdy and robust as an outdoor screen.

A semi-outdoor screen is indoors, but still exposed to direct/indirect sunlight. The LED semi-outdoor screens usually produce less light because there's natural light in the room.

It'll also have sensors that will tell the screen to adjust its brightness as lighting conditions change through the day.

Outdoor screens are common in the **retail and QSR verticals**.

Need an example?

Drive-through menus and have special casing and specifications on how much light is omitted so you can still read it in direct sunlight. They have powerful cooling systems, and can continue working in extreme heat, cold, wind, and so on.

The more extreme the conditions, the more specialized and thus expensive your outdoor sign will need to be. There's a lot more environmental stress in Alaska or Arizona than in Indiana.

Commercial or Consumer Display?

A screen that's left on for long periods of time is prone to the aforementioned burn-in, not to mention overheating.

And in retail and QSRs, screens are often left on 24 hours a day.

A typical consumer screen—one you'd just pick up at a Big Box store—might not last long in a commercial setting, because they're meant to be used only for a few hours at a time.

And even in your home, they're not expected to last more than a few years.

They're made with less expensive and hardy components. Plus, using a consumer display commercially might void its warranty. Finally, they aren't designed to work in portrait orientation, which is commonly used in menu boards **at QSRs**, for example.

Commercial screens may appear to be more expensive if looking just at MSRP, but when taking into account Total Cost of Ownership a different story is told.

TOTAL COST OF OWNERSHIP

(4 to 8 year of expected operation of the panels)

When comparing consumer TV pricing to Commercial Display pricing be sure to look at:

- Difference is scalability and functionality (consumer TVs have limitations)
- Look at Power Consumption Costs.
- Replacement cost of Hardware in Consumer vs. Commercial Displays,
- Difference in Warranty,
- Difference in hours per day usage. 6 hours for a TV, 12 to 24/7 for commercial displays
- Understand that: **All flat-panel display models are not created equal**

A single replacement of a consumer quality display panel can increase its cost over the commercial grade panel, and operational economies may be sacrificed since commercial-use features are typically not included in home-use TVs.

CONSUMER TVs:

1. Consumer (in-home) TVs are produced for a two- to four-year life operating four to six hours per day (depending on the brand),
2. Warranties reflecting this ruggedness are typically for one year on the consumer TV
3. Consumer TVs are not designed to operate in portrait mode and they usually lack the inputs and display controls that maximize the return on the digital-signage investment.

Consumer quality TVs are not suitable in dirty, hot or humid environments and are a false economy over using commercial-grade flat panel displays.

COMMERCIAL DISPLAYS:

1. Commercial-grade flat panels are engineered for 60,000+ duty hours, (18 hours of operation for 365 days equals 6,570 hours of operation per year).
2. Commercial grade warranties are three to five years on the digital-signage display.

3. Display OEMs typically use commercial-grade components that are designed to prolong the life of the display where heat, dust and humidity are elements of the display environment.

Conformal coating is a thin protective chemical coating or polymer film that is topically applied to circuit boards to protect electronic circuits from harsh environments. When applied, this breathing coating "conforms" to the circuit assembly, filtering water vapor and solid debris.

LED lighting and commercial-grade components can be effectively cooled using convection, typically negating the need for supplemental fan cooling.

Fanless flat panel operations reduce noise and energy requirements while pulling less contaminated air into the workings of the display device.

But don't stop reading there!

They're designed to disperse heat properly (whether oriented vertically or horizontally). They also have built-in anti-burn-in measures, though many consumer displays do as well.

Thanks to features like anti-glare glass and ambient light sensors that adjust brightness automatically, they should also be more readable.

They also have other features, such as control locking, ability to recognize more resolutions and refresh rates, better contrast, and more connector options.

Not every application requires a commercial-quality display, but between the longer lifespan and the warranty, plus the added utility, it may pay for itself.

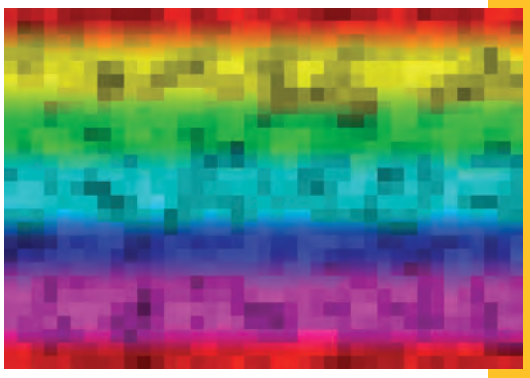
How Should the Picture Look?

Your beautiful content will be even more eye-catching on a screen that's optimized to display it.

And different types of content and uses have different screen property requirements that'll help them look their best.

There's some *key terms you need to know.*

- **Pixel pitch:** Pixel pitch refers to the distance between pixels. A small number indicates a high density of pixels, and thus the ability to produce a sharper image[78].
- **Display resolution:** Resolution refers to the total pixels in the screen, and is expressed in terms of horizontal pixels x vertical pixels. For example, 1920 × 1080, which is sometimes referred to just as 1080. Or 4K, which is shorthand for a horizontal resolution of about 4000 pixels. While it doesn't tell you pixel density, it lets you know how many pixels they are and how they're arranged. *Content that matches the display's native resolution will look best.* So, while 4K is trendy, unless your content matches that high resolution, it won't do you much good[79].
- **Aspect ratio:** Aspect ratio is tied to display resolution. It refers to the ratio between a screen's width and height. *A 1920 × 1080 screen would have an aspect ratio of 16:9.* If the aspect ratios of your screen and content don't match, the image may end up squished, stretched, or surrounded by black gaps.
- **Brightness:** Brightness just refers to the *light output of a screen.* In digital signage, it's measured in nits.
- **Contrast rating:** A high brightness contrast between white and black regions on the screen lends depth to images. In general, a contrast rating of at least **20:1**, even in full light, is desirable.



- **Frame rate:** Frame rate refers to how often your screen can display consecutive images, or frames, and is typically measured in frames per second (FPS)[80]. The higher the frame rate, the smoother on-screen motion looks. The screen can update the image one pixel row at a time so that the entire screen gets refreshed at once (progressive scanning) or by updating first even rows and then odd so that the entire screen gets refreshed every two frames (interlaced scanning)[81].

- **Color gamut:** This term refers to the range of colors the screen can show[82].

While it sounds like a higher gamut would be better, it all depends on your content. The color gamut of the screen should match the standard color gamut of the content, called sRGB. Any higher and you get unrealistic, oversaturated colors. Related: the ambient light affects how the colors on the screen look, and some displays are optimized to look best under, say, fluorescent light.

Your needs for all of these will be determined by your use case: the lighting conditions, size of the screen, viewing distance, and type of content, among others.

For example, envision a vehicle showroom (surrounded by windows) with kiosks that let customers learn more about the products.

The screens would need a high resolution and refresh rate so that videos of the cars can play without blur and highlight all those design subtleties. Plus, the images would need to look good in bright, natural light.

If you can spell your use case out for the OEM or the digital signage partner you're working with, they should be able to direct you to the right screen.

How Should the Screen Look?

Depending on your vertical and use, the aesthetics of the screen itself might be important.

Size

Screen size will be *closely related to and limited by* your choice of screen type.

Flat panels (that is, non-projection options) rapidly become more expensive above 55". This might indicate that a projector might be a wise choice.

The screen should be large enough to display the necessary information in a way that will be legible at the distance your viewers will be positioned at.

With an LCD screen[78], use the **4/6/8 rule**.

That means that viewers can be four times the image height away in order to process complex information, *six times* to view simple information, and *eight times* for casual perusal.

With LED, take the pixel pitch and multiply by 1000 to find the *minimum* viewing distance—that is, the distance at which the image stops looking good. Think about a pointillist paintings: what looks like a pleasant riverside scene from a distance looks more like a mess of dots up close. For *maximum* viewing distance, the 4/6/8 rule applies.

No analytical method yet exists for finding the minimum viewing distance for a projected image, but it looks like one's on the way[77].

Bezel

The bezel is the plastic or metal rim around the screen.

You may wish to have an unobtrusive bezel for aesthetic reasons.

If there are many displays next to each other, such as with a video wall in a retail setting, you want a thin bezel so it doesn't cut words in half if content is stretched across multiple screens.

Mounts

Choosing a mount is all about *finding one that fits your budget and positions your screen the way you want*. It's much more straightforward than picking a screen or media player.

Here are the most common options.

Basic Mounts

- **Flush:** The simplest type of mount. These position your screen on the wall so its back is parallel to the wall. You might find these in hallways or behind a welcome desk.

- **Tilt:** This type mounts your screen at an angle. It might be useful if your screen is located above eye level, such as with a digital menu board.
- **Articulating:** Articulating mounts place a screen at the end of an arm so the angle and direction it's facing can be changed.

- **Ceiling:** Rather than hanging from the wall, some screens dangle from above thanks to ceiling mounts. I've encountered them at airports—at the gates, there are often ceiling-mounted TVs playing the news.
- **Pedestal:** Pedestal mounts rise from the floor. In a large space with walls that are far away, and especially with interactive screens, these can be practical.

Kiosks and Other Specialty Mounts

Kiosks *enclose screens within a casing* for aesthetic appeal, to protect from vandalism and other environmental factors, or to make them easier to interact with.

They often cost more than basic mounts and may be built out of premium materials to provide visual appeal and greater protection for the hardware inside.

They're as diverse in forms and sizes as basic mounts, and tend to be designed for specific purposes.

Often, the screen and the enclosure come as a "package deal," but sometimes they can be purchased separately.

There are other types of specialized mounts.

Some kiosks may have *additional components* built in[83], such as a camera, card reader, or infrared sensor.

Others may be built with specialty materials to fit the setting they'll be placed in—for example, antibacterial plastic at a hospital.

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