



LED DISPLAYS: CONTENT AT THE CORE

PRESENTED BY

 NanoLumens

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LED DISPLAY CONTENT YOU GET WHAT YOU PUT INTO IT

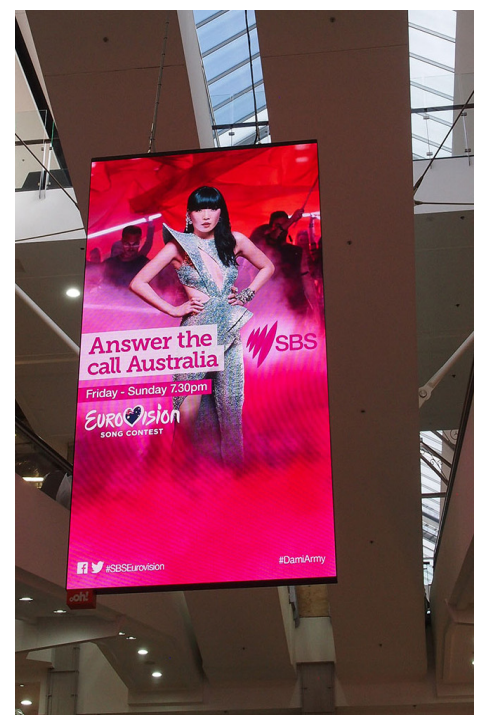
An LED display is a magical piece of technology, but it is only as good as the content it displays.

LED DISPLAY CONTENT. YOU'VE GOT QUESTIONS....

An LED display is a magical piece of technology, but it is only as good as the content it displays. After all, a display is ultimately designed to be a messenger; a tool to convey information, inspire emotions, and incite wonderment. Because an LED display is built for the specific purpose of showing content, there are naturally countless questions to be asked and answered regarding the presentation and production of that content. Not every display will showcase content at the same level of performance and precision, and not all content to be showcased gets created with the same care and creativity.

What this white paper hopes to establish is a baseline of understanding of the role content plays in the life of an LED display.

There are three fundamental steps involved in creating an effective LED solution: Build a superlative display, create exceptional content, and finally, establish where and how your content will be seen. An LED display revolves around the content it shows. Businesses taking the step to purchase a display ought to be well-versed in everything that goes into that.





THE INSIDE OF YOUR TECH IS AS IMPORTANT AS THE OUTSIDE

High-tech marvels of modern technology, LED displays are game-changers wherever they are installed, but the content they show will fall short of the goal if it is not displayed as it should be.

If your business is going to spend a substantial amount acquiring and installing an LED display, you want to make sure it will display your hand-some content in the truest and most accurate way possible.

Audiences viewing content that appears splotchy, low-quality, or simply not quite right will lose interest quickly. Instead of focusing on the substance of your content, audiences will instead pay attention to the superficial appearance of it. That's not good. Content is rarely cheap to produce, and businesses cannot afford to waste resources showing beautifully designed content on a lackluster display.

WHY DOES CONTENT APPEAR BETTER ON SOME DISPLAYS THAN OTHERS?

The reason the quality of content varies across LED displays is because the displays themselves are not

always built under the same production standards. Some manufacturers pride themselves on going the extra mile to produce the highest-quality solution, but others cut corners to lower their front-end sticker price in hopes of roping in customers focused only on initial cost. In order to make sure the display you are installing will show your content exactly the way you want it to, it is worth investigating certain parts of the manufacturer's production process. To do so, let's start at the very beginning, when the pixels of a display are first built.

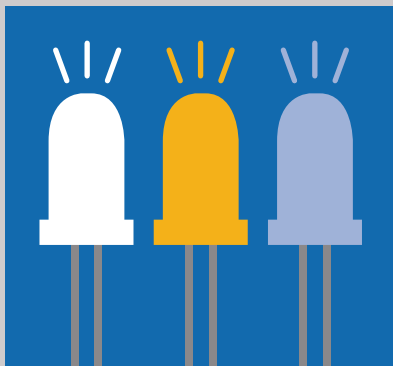
A CHAIN IS ONLY AS STRONG AS ITS WEAKEST LINK

This same sentiment can be applied to an LED display. Though the diodes within an LED display can seem identical to the naked eye, every diode is not made equal, and

one bad diode can compromise an entire display. Each diode made in a given production run will exhibit tiny variances from the others in its batch, despite the fact that they were all created with the same materials. For this reason, manufacturers sort newly created diodes through a classification process that groups together like diodes.

This diode sorting process is referred to within the industry as "binning," and generally, the two criteria manufacturers use to bin their diodes are color wavelength and forward voltage. These two metrics measure the specific color profile and brightness levels of a given diode, and as you can imagine, the narrower the parameters are for each group, the more similar each diode's performance level will be to that of the diodes it's grouped with. Displays built with like diodes from the same bin will exhibit a more

WHAT IS A DIODE?



A light emitting diode, or LED, is essentially a small light bulb, but unlike incandescent light bulbs, it does not contain a filament, thus making it more efficient. An LED also has a longer life span, lasting approximately 50,000 to 100,000 hours for a higher-quality LED — or about 5.5 to 11 years.

cohesive picture of your content whereas displays built with varied diodes from diverse bins can show content that appears spotty and interrupted. For example, imagine your content contains an image of a man in a dark black suit. On a meticulously binned display, that entire suit will be the same dark black, but on a display built with blended pixels from a range of bins, the suit might appear different shades of black in different areas of the picture.

Due to the outsized impact diode consistency can have on the appearance of display content, the precision with which binning is performed is one of the primary differentiators between top-end manufacturers and their lower-quality competition. The companies that use the best, most consistent materials are the ones that produce the best finished products, just as, for example, a chain manufacturer that uses superlative, highly similar links will create a better end product than a manufacturer using a scattered blend of links ranging in quality.

WHAT WILL MANUFACTURERS DO TO HIDE THESE DEFECTS?

Lower-end LED manufacturers buy their diodes from across their supplier's entire production run and then blend these varied diodes together when building their display. To remedy these inconsistencies, manufacturers perform a smoothing process called calibration. This process improves the consistency of the display, but it reduces the brightness, resulting in a proportional decline in grayscale uniformity.

In simplest terms, gray scale uniformity defines the color depth of the display. Essentially, it indicates how well a display's picture differentiates varying shades of the same color within a piece of content, and how consistent a given color appears across the entire display. Does Coca-Cola red stand out the way it should? Is it the same across the whole display? If gray scale uniformity is poor, the answer to those questions will be no. Content on a display with poor gray scale uniformity will appear inconsistent, with some areas showing darker tints of a color as other areas show lighter shades.

Recall the example of the man in the dark black suit. Now imagine that man is standing next to someone wearing a gray suit. In a calibrated display that has lost grayscale uniformity, these two suits might appear to be the same color. That's a problem. A display built with diodes that have been expertly binned will always show the difference between black and gray suits, but a display requiring calibration might not. The absence of strict binning policies from a manufacturer could leave you overpaying for something that will underperform as soon as it arrives on site. That's an even bigger problem.

AS PIXEL PITCH SHRINKS, THE IMPORTANCE OF BINNING WILL GROW

Differences between diodes and the reduced performance of calibrated displays will be noticeable for audiences viewing content from shorter distances, so it is crucial to understand the binning policies of each LED manufacturer; their process matters a lot more than you might have previously thought. NanoLumens displays use only like diodes from the best-performing bin, and thus our displays perform at a much higher level than displays using varied diodes that need to be calibrated. After all, a chain is only as strong as its weakest link, and an LED display is only as good as its worst diode.

A WORLD-CLASS CANVAS DESERVES WORLD-CLASS PAINT

In order to be productive, a great display needs great content. Once you've developed an understanding of how your display will perform, you need to return to the process that generates the content it will showcase. In order to get the absolute most out of an LED display, the content you push out needs to be excellent. Audiences are bombarded by thousands of pieces of digital messaging each day, and only the best of the best ends up sticking with them. LED displays grant an incredible opportunity to grab the attention of consumers, but the onus then is on the content creators and managers to do something with that attention.

SCHEME UP A DYNAMIC COLOR STRATEGY

The Institute for Color Research published a study concluding that people make lasting judgements about content within their first 90 seconds of exposure, with a disproportionate share of this judgement dictated by the colors the content employs in conveying its message. For those who handle content creation in-house, consider that well-designed digital signage content reflects on the implications of color research and crafts a color strategy to attract attention, spark emotional reaction, and call an audience to action.

When determining your color strategy for digital display content, it is recommended to start by choosing a pair of colors opposite each other on the standard 12-spoke color wheel. Colors opposite one another on the wheel will have a high degree of contrast, which ensures that your content will stand out no matter what. Employing these two colors in a rough 7:3 ratio will establish the implicit psychological tone of your dominant color while allowing consumers' eyes to rest on the accenting secondary color, which will shine in its smaller role. Finding the right balance between colors within your scheme is imperative to appearing professional, direct, and focused to audiences. Consider their needs as well as your own, and spend time solidifying which colors are best for getting your message across. NanoLumens LED display technology shines bright enough that your colors will fill the entire room, so it is crucial to choose the right ones.

OPTIMIZE CONTENT AROUND INDUSTRY TRENDS

A structured and well-documented strategy is key to the successful execution of a modern content initiative. This strategy must highlight your organization's goals and objectives, while remaining true to what it believes in. Audiences expect brands to be authentic about their ideals, and a well-thought out content strategy should represent these beliefs transparently. Authenticity is at a premium in today's market as audiences increasingly desire something real. The heart and personality of a group is an asset, and it should be treated as such. Don't simply use content to sell products or services, use it to sell the ideals of your organization.

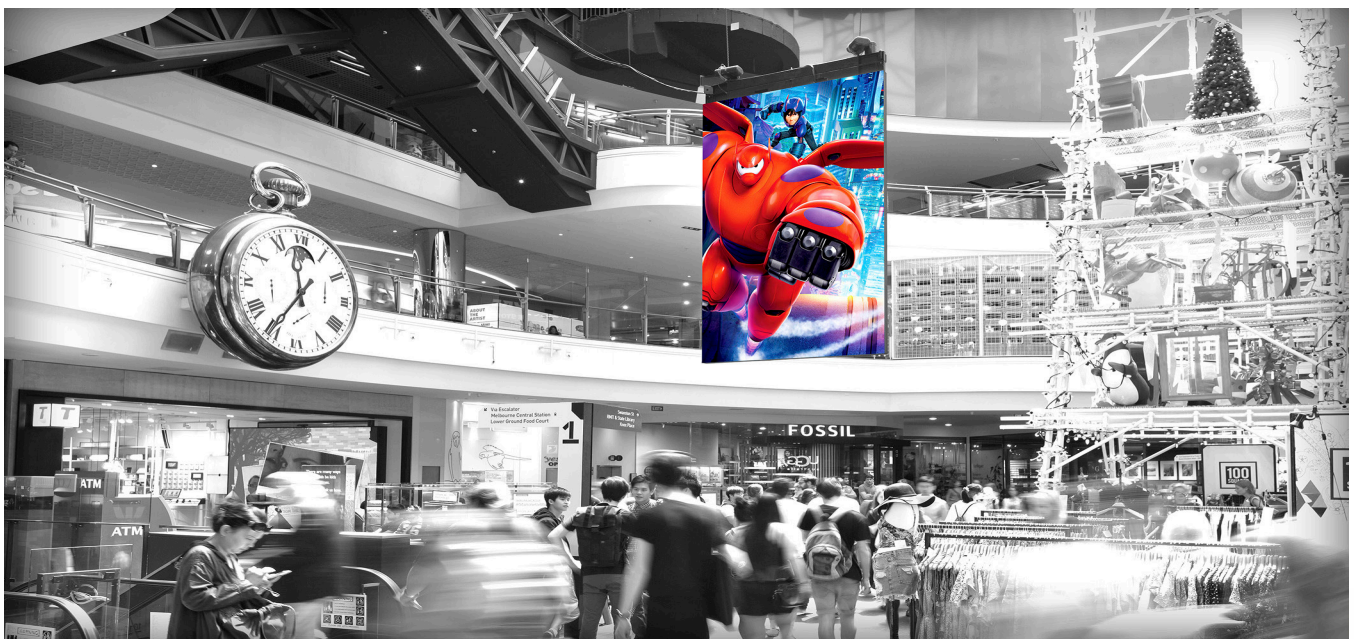
The reason content is king is because it not only promotes the brand, but it tells - and sells - a story. Understanding the growing trends in digital display content is crucial to constructing that narrative. Attention spans are shrinking, and content needs to adapt to keep pace. That means including more authentic content to advertise the values of your business or organization and encouraging viewers to generate their own content in order to expand the reach of your brand.

CONSUMERS RECOMMEND BRANDS TO PEERS IF THEY FEEL A PERSONAL CONNECTION

Peers are subsequently more likely to trust that recommendation, since it is coming from a fellow individual, and not the brand itself. Studies have shown that people trust content made by other individuals more than they trust content created by brands, so if you are able to motivate audiences to generate content on their own, you are not only exponentially growing your reach, but you are doing so in a way that the public is more likely to give credence to. Use your display content to motivate users to post with your brand's hashtag, or to share the details of their positive experience. Ideally, this will help cultivate a community of interest around your brand, and sharing this kind of user-created content also conveys the message that the voices of your audience are being heard.

AUDIENCES CRAVE A STORY TO FEEL PERSONALLY INVESTED IN

Many modern digital displays are able to use sophisticated beacons to identify audiences, show them content specific to their interests, offer recommendations, and then analyze that data so content managers can adapt their display as needed. When a viewer is treated to a personalized content experience, he or she feels valued by the organization. That sense of respect is then reciprocated, who sees the business or group in a more favorable light and becomes more likely to take action. By using your content to speak directly to individuals as individuals, you will set your organization apart. Additionally, allow audiences to customize their experience on their own. Give them the means to participate, and you will foster a stronger connection with your brand!





BEAUTY FROM ALL ANGLES

Once you know your content is exceptional, and that it will look beautiful on a scrupulously binned LED display, the last thing you need to figure out is where your content will look beautiful *from*.

When you wander into a Best Buy to check out a new television for your living room, you don't make your decision simply based on how the on-screen content looks when viewed straight on. You move around, you walk from side to side, and you do this because you know that once the TV is in your house, you want your family and friends to be able to see high quality content from a wide range of angles. You may even have been burned in the past by a television that loses its contrast or color uniformity when viewed from the side. This same due diligence applies when researching large-format LED displays.

WHERE CAN I SEE THE DISPLAY FROM?

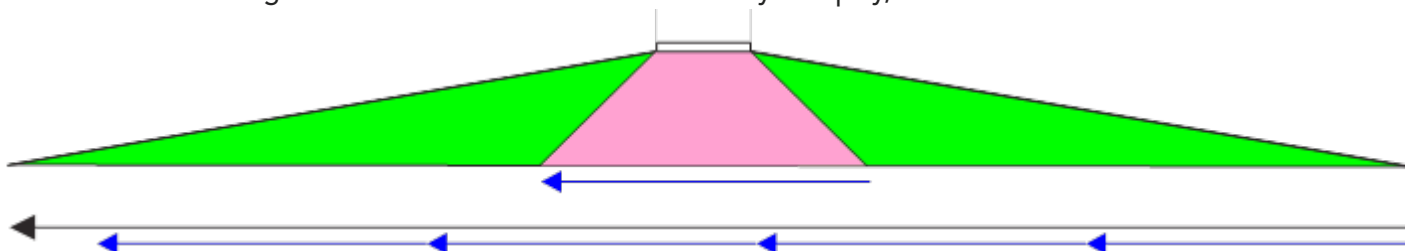
Businesses choose to install large-format LED displays for the specific purpose of attracting attention. LED's are brighter and

more powerful than their digital relatives, and are uniquely equipped to engage the interest of audiences from an array of viewing distances and angles. They can be installed almost anywhere, which means the content they show can also be viewed from almost anywhere. This makes it imperative that LED displays are optimized for off-axis viewing. Off-axis viewing is a phrase used to describe the act of looking at display content from an angle that is at least one degree away from center, or in simpler terms, from the side.

A FUNDAMENTAL REASON WHY OFF-AXIS VIEWING IS SO CRUCIAL IS BECAUSE LED DISPLAY CONTENT IS OFTEN VIEWED BY A MOVING AUDIENCE

These digital displays are frequently used in high-traffic areas where viewers are walking around, and as a viewer walks by a display,

the amount of time he is able to see-content is a function of the off-axis viewing capabilities of the display. For example, if a display only has an off-axis angle range of 90 degrees, or 45 degrees from center each way, a viewer will only be exposed to the content while he is within that range. Once he has moved beyond 45 degrees to the right or left of center, the display content is no longer cleanly visible. In contrast, a display with a viewing angle range of 160 degrees, or 80 degrees from center each way, allows for over 4 times the total visibility. In the image below, the pink region represents the visible area for a display with a 90 degree off-axis angle range, while the green region represents the additional area that becomes visible for a display with a 160 degree range.





In order to be effective, content needs to be seen, and the longer someone sees content, the more likely it becomes to leave an impression. The better the off-axis ability of the display, the longer your content will be viewable, and the more likely it will be to influence audience members. At the risk of oversimplifying, LED displays are designed to show content. The more versatile a display is with regard to off-axis viewing, the better it is at its designed purpose, and the more value it will provide to you.

WHERE IS MY CONTENT GOING TO SHOW UP?

Businesses and organizations who make the decision to purchase and install an LED solution are not buying their display off the rack. They are partnering with a manufacturer like NanoLumens to arrive at a fully customized solution. That means the display being installed is built to fit a specific space and a specific purpose, which usually means it will have non-standard dimensions. Perhaps the space demands a display that is far wider than it is tall, or possibly a square-shaped display is the right way to go. Regardless, because LED displays come in all shapes and sizes, confusion can arise when you try to import content onto them. The standard aspect ratio that most generic screens and displays - and therefore the content they showcase - are made with is 16:9, but, as mentioned above, the display size and shape that is best for your business might be something completely different. For that reason it is important to understand how to “map” your content onto your specific display. Content mapping is the industry term used to describe the process of configuring your content to fit within the parameters of your unique display.

LED displays are measured by their pixels: pixels wide by pixels high. The threshold for a true high definition display is 1920 pixels by 1080 pixels, but it is entirely possible –likely, even- that your display has different dimensions. 1920 by 1080 represents a 16:9 ratio, but if, for example, your display has measurements of 1900 by 500, you will have to make some adjustments. Adjustments, namely, to your content. While it’s true that you could import traditional 16:9 content to your display and it would show up, what that fails to mention is how it will show up. Your content that was designed for a 1920 by 1080 display could compress, or smush, itself to fit in the smaller display, or the display could simply cut off large portions of the content and only show a 1900 by 500 sized section of it. Displays are designed for the purpose of presenting content. Don’t corrupt that purpose by importing content that the display can’t accurately present.

CUSTOM DISPLAYS REQUIRE CUSTOM CONTENT

You installed an LED display so that you could use it to display content. This content needs to show up without blemishes, and it needs to be visible from a wide range of angles, but perhaps most importantly, it needs to show up properly on your display. The far more responsible way to map content onto your custom display is to create content with the proper resolution right from the start. If your display is 1900 by 500, take the pains to create content that is 1900 by 500. You wouldn’t use ill-fitting tires on a Ferrari, so don’t import poorly mapped content onto an LED display. Make the extra effort on behalf of your display, and the solution you arrive at will make it all worth it. Content mapping is a relatively simple, but immensely important task that content managers absolutely must consider before pushing their content out to the world. After all, what good is beautiful, widely visible content if it is distorted when you send it to your display?

Tips for Compelling Content

Your LED signage investment will not yield many benefits without superior content. Start the content development process by answering these five questions:

1. Who is your audience? Messaging must be properly targeted to your audience, so bear in mind their age, gender, and other demographic data, as well as whether viewers consist of new or existing customers.

2. What is the purpose of the installation? Determine whether you're looking to create an atmosphere, display branding, share offers or meet other goals, and develop content accordingly.

3. How frequently will the content be viewed? The more often it will be viewed, the more it should vary so that viewers will stay engaged.

4. For how long will viewers experience your content? If your audience will remain captive for longer periods, the content should change often. For viewers who will experience your display in passing, use eye-catching content that will capture their attention.



5. Who will create your content? You can create it in-house, but you also have many options for using outside vendors — ranging from automatic content from licensed content companies to rendered content from agencies or individual contractors.

Under every circumstance, remember these tips for compelling content:

- Graphics capture viewer attention and engage them quickly. Replace text with graphics whenever possible and appropriate, and use bright, high-contrast colors.
- Animation, too, is effective at grabbing viewer attention, but be aware that producing it will raise content costs.
- When including text in your displays, use large font sizes to optimize readability.

Go Forth and Maximize Your Display's Potential

We at NanoLumens pride ourselves on pioneering the future of digital display technology, and we steadfastly believe that our LED displays will help carry the industry forward. We build these transcendent installations so that our partners can use them to showcase their incredible content, and we keep that purpose in mind every step of the way. Businesses turn to large-format LED displays because they need a feature that can brilliantly display content to consistently dazzle viewers, every time. Critical to accomplishing that goal is understanding the ins and outs of how displays and content work together.

A FEW WORDS ABOUT



NanoLumens, headquartered in Atlanta, Georgia, creates display visualization solutions that deliver truly immersive customer experiences and great return on investment.

BRIGHT THINKING

Headquartered in Atlanta, Georgia, NanoLumens partners with clients to create uniquely compelling, interactive LED visualization solutions that take the guess work out of owning a display network. As the fastest growing visualization company in the US, our experiential LED displays exceed the imaginations of global clients in retail, transportation, corporate, gaming, higher education, sports and arenas, and houses of worship. Through world-class proprietary technology, NanoLumens displays are ultra-thin and lightweight, energy efficient and available in any size, shape or curvature. NanoLumens solutions are proudly designed and assembled in the United States of America and come backed by an industry-leading six-year warranty.

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