

Digital Out of Home

A Primer | Section 2

Technology & Infrastructure: How do I build and operate a digital out of home enterprise?

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Key players you need (talent required)

There are many types of business models that provide potential network owners options for adding digital signage to their organization. These include but are not limited to:

- Turnkey providers that provide everything, from hardware to content (or everything except content)
- Integrators that design and install systems, with optional maintenance contracts
- Purchased outright, owner-maintained and owner-operated
- Ad-subsidized networks -- vendors install networks and take a larger percentage or all of the advertising revenue, but provide the digital signage system at a reduced cost or no cost)
- DSaaS - Digital Signage as a Service -- systems are typically leased for a fixed monthly cost, for a set term

Bandwidth & Network

A dispersed digital signage network is a network utilizing multiple displays over a geographically large or small area. This area may be a single building or a single campus, as well as citywide or nationwide. The network connectivity could consist of standalone units, a wired LAN, Wi-Fi, cellular broadband or a combination of these. Content management will be by a single CMS and player platform, System on Chip (SoC) or multiple content management systems and player types. Presentation and playlist changes can be as simple as a standalone unit running from a USB, to as complex as a nationwide network managed through a cloud-based or enterprise platform. Regardless of the components making up the network, making sure you have the proper tools and support in place will enhance management productivity, maintain connectivity and enable future capabilities.

Keys to managing the network efficiently:

- Have display and network status communication protocols in place. Should a display or media player go down or network connectivity be lost, have an established system for reporting. This could be by a system notification via email, or on-site personnel instructed to call a support number. Communication is key to eliminating downtime.
- Know your CMS and hardware well. Understanding the platform, scheduling, content types and where the content is originating from will help eliminate many content issues unrelated to the display or media player. Many times, a black display is a content issue and nothing more.
- Have a "display down" plan of action in place. A checklist as to the mission critical relevance of the display should be considered. Is there redundancy in place? Do you

have local trained support techs available for onsite resets or replacements? If so, make sure the local support team is aware of a confirmed service-level agreement (SLA) in advance. This adds value to the product regarding services and increases response time.

- Establish a Responsibility Communication Flowchart. Content schedules, network permissions and support, facility and location access are managed by someone other than you. Have a communication list in place for quick notifications and permissions to access and correct issues. Include your hardware and software vendor support as well as third party onsite support/installation provider. Many times, warranty issues require multiple people to be involved and working together throughout the resolution process.
- Plan for the future. Establish a potential growth plan with the client. Will there be an increase in locations, change in type of content or change in the size and scope of the displays? Preparing for these items in advance will keep you as their management support. It will allow for you to train and prepare for network upgrades and growth. This includes new locations and retrofitting locations to upgrade to the platform.

Whether the network is local or nationwide, homogenous to one CMS, player and connectivity type or a hybrid of all three, understanding every attribute of the solution you are managing is key. Having the right communication support, network component knowledge and on-site personnel will enable you to manage the network more efficiently and successfully.

Display Types and Selection

There are several types of displays available for consideration in a digital signage system – primarily flat panel monitors (such as an LCD displays or OLED displays), direct-view LED displays (such as those in Times Square or large displays viewed from a distance at sporting events) and projectors.

Flat panel monitors can also be arrayed into what's called a video wall format, in which multiple displays are placed next to each other, to present a larger image than could normally be achieved with a single flat-panel monitor. A video wall can be small - a 2x2 video wall is four flat panel monitors arranged in a two-on-top, two-on-bottom configuration or huge configurations with many displays.

Flat Panel Displays

There are two primary types of flat panel displays, which are LCD (Liquid Crystal Display) displays and OLED (Organic Light-Emitting Diode) displays. Plasma displays fell into this

category, but are rarely if ever used anymore due to energy usage, weight and improvements in LCD technology. It is likely we'll see more technologies that fall into this flat panel display range.

Flat panel LCD Displays

LCD stands for Liquid Crystal Display. The liquid crystals are sandwiched together between two pieces of glass. The crystals don't produce light themselves, so another light source, such as an LED, OLED or CCFL must be used. (In consumer TVs, "LED TVs" are actually LED-backlit LCD TVs, which has caused some confusion in the marketplace.) The image is created when an electric current is sent through the crystals, which causes them to shift and show an image, which is visible when a light shines through the moving crystals.

LCDs are bright, widely available in a range of panel sizes and resolutions and generally the most affordable display option for smaller display applications. LCDs become less affordable as they become larger, and max out around 110" diagonal for a single display. Many digital signage applications require displays larger than this. For those applications, you would need to consider using an LCD video wall, direct-view LED or projector.

LCDs also have visible bezels, with less expensive displays typically having wider bezels. In some cases, bezels can be only millimeters thick, but are typically still visible to the human eye, depending on how close a person is standing to the display. This is mostly an issue to consider when using LCDs in a video wall format.

LCD details:

- Sizes range from 3" to 110" with many variations in size of panels available
- Can be used as individual displays or tiled for video walls
- Must have a light source within the panel, such as an LED or CCFL
- Displays can be either edge-lit or back-lit
- Current resolutions include 1080p, 4K and 8K
- Very wide range of qualities and prices
- Can be used in indoor and outdoor applications, either natively (if it's an outdoor rated panel) or within outdoor display housing, such as a kiosk
- Can be curved
- A wide range of brightness levels available
- The most affordable option for displays in digital signage
- Have visible bezels
- Reliable technology with long lifespan, with some commercial versions easily able last for years even with 24/7 usage

OLED Displays

OLED (Organic Light-Emitting Diode) displays are a fairly new technology for use in larger formats, though they have been used in smaller applications such as cell phones, for longer. The emissive layer is sandwiched between a cathode and an anode. OLEDs are sensitive to oxygen, moisture and other environmental factors and must be encapsulated.

Only recent manufacturing improvements have allowed larger format OLED displays to be available to the market. This is a newer technology, and only available from a few manufacturers, but it has many potential advantages for digital signage applications – brightness, flexibility, thinness, ability to be two-sided, even in curved applications. There is likely to be a lot of rapid development, with more options and lower pricing becoming available. At the moment though, OLEDs are limited in availability, particularly in the size of the panel, and expensive.

OLED details:

- Limited sizes available – mostly 55” panels, though an 88” was announced in 2018
- Does not use a separate backlight like LCD displays, since pixels are self emissive
- Displays are very light and thin, in some cases being only 4 millimeters thick
- The thinness of the material easily allows displays to be two-sided
- Current resolutions include 1080p, 4K and 8K
- Has a wide range of flexibility and can be curved, both convex and concave, including two-sided applications
- Can be transparent
- Can be used alone or in video-wall applications
- Has visible bezels
- Still a fairly fragile display technology

Direct-View LED Displays

Direct-view LED displays have been around for a long time. An example is what you might know as Jumbotron – the big displays at stadiums and concerts that you’ve seen for decades. (The original JumboTron was produced by Sony in the 1980s, and even once other manufacturers came into the market, the word “jumbotron” became the word everyone used to describe direct-view LED displays they saw in these locations.)

LED stands for light-emitting diode. On direct-view LED displays, the LEDs are mounted directly on a panel and produce both the light source and a color, which changes depending on the voltage of the electricity passed through them. If you walked up to one of these displays, you can easily see the individual LEDs, and even touch them, because there is no glass covering the LEDs.

The size of these LEDs is what's known as pixel pitch. The smaller the pixel pitch, the higher the pixel density and the closer a viewer can be to the display. Pixel pitches range from 0.7-millimeters to 10 millimeters. Displays with smaller pixel pitches and higher pixel density are more expensive and less rugged than those with larger pixel pitches.

The panels the LEDs are mounted on don't require bezels, since there's no glass that needs protecting, so when many panels are combined into a video wall, very large displays can be created that appear seamless to the human eye. They are available in smaller, manageable panels for transport and access for maintenance, but the total sizes of the walls are virtually unlimited. Most of the largest displays you see outdoors – electronic billboards, displays on the side of skyscrapers, the displays in Times Square or Piccadilly Circus – are direct-view LED displays.

Direct-view LED display details:

- Can be used in either outdoor or indoor applications, and are the most common choice for large format, outdoor display applications
- Resolution is dictated by total wall size and pixel pitch
- Can be curved
- Wide range of brightness levels, and is typically the brightest option on the market for applications with direct sunlight or high ambient light
- Panels are robust and reliable, with some options being ruggedized
- Ideal for applications in which displays need to be moved around
- Virtually limitless in size
- Similar life length to LCD displays
- Generally more expensive than LCD displays

Projectors

Projectors are not extremely common in digital signage, but there are few reasons to consider them in certain applications.

Projectors must be projected onto a surface, either from in front or behind, and nothing can obstruct the area between the projector and what it's being projected on. Short throw and ultra short throw projectors use a special lens that allows them to throw a large picture even from a very short distance -- typically inches or centimeters and not feet or meters -- and other technologies like off angle lens shift make it possible for a projector to be placed where it's convenient for the application without affecting picture quality.

There are many types of projector technologies in regular use today – DLP (Digital Light Processing), LCD (Liquid Crystal Display), LED (Light Emitting Diode) and others, as well as a few different light source technologies used in conjunction with them – traditional lamp-

based projectors, laser, laser-phosphor and also LED, again. For example, a projector can be both DLP and LED, or just LED, since LED is both a light source and a way to show an image.

Most digital signage applications would use a laser or laser-phosphor projector because they last much longer and are more robust than their counterpart technologies. Lasers, unlike lamps, are what's known as solid state – they don't have any moving parts. Lamps have to be replaced, sometimes as much as three or four times over the life of the projector itself, because they both burn out and dim over time. Lasers last much longer and need much less maintenance during their lifetime. That makes the total cost of ownership less expensive over time, even though they're more expensive up front. Lasers are also significantly brighter than LED-based projectors (another type of solid-state projection), which most digital signage applications require.

Laser-phosphor is a kind of compromise technology – projectors using laser-phosphor are brighter and less expensive, but they don't last as long or maintain their brightness levels as long as a pure laser projector does, which are also considered to have superior picture quality.

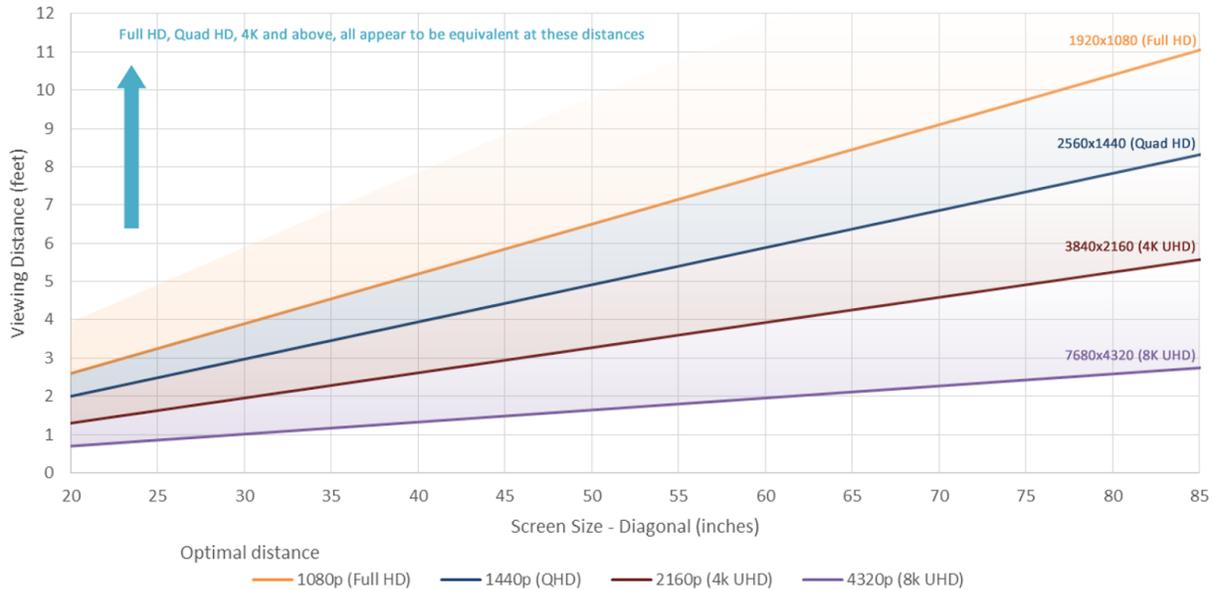
You would typically only consider using a projector in digital signage if you needed a large display image and for whatever reason, a video wall doesn't work. The area perhaps can't support the weight of the displays and their mounts, but can support a projector, or you don't want visible bezels or pixels. If your digital signage application can accommodate a projector, it may also end up being significantly less expensive than the same size video wall.

The biggest potential advantage of projectors over panels is something known as projection mapping. Using special software, projection surfaces can be mapped and then content designed for that particular surface, no matter how irregular the texture or shape is. Almost anything of any size can be projected on, from small 3D objects to skyscrapers. The final result is nothing less than artistry. Many famous buildings, from the Sydney Opera House in Australia to Big Ben in London, have had projection mapping displayed upon them. This unique digital signage application is only possible with projection. It also requires content designers and projection experts with specific expertise and special software.

Projection is also useful for temporary or part-time digital signage use cases because when not in use, projection surfaces can "disappear" much more easily than any kind of display, which will be a big, black box that must be covered up physically to disappear. Projection can be projected on anything (with projection mapping technology), and projection screens can be different colors and textures that more easily blend in with the environment around it when the content is off.

Display Size

The ideal display size depends on the audience size and typical viewing distance. Below is a chart that illustrates ideal display size and resolution based on audience distance.



Hardware Shelf Life

Commercial vs. consumer grade technology products

For budget-minded network owners, it may be tempting to consider using consumer products, particularly displays (TVs), which are often available in the same sizes as commercial displays for less money. While that is certainly an option, some of the reasons to use commercial-grade hardware can be less obvious at the outset. Considerations for why using commercial grade hardware (displays, media players, etc.) are more preferable to consumer grade equipment for digital signage include:

1. Duty cycle use -- consumer products are much less robust since they're not built to be used for long periods of time
2. Total cost of ownership (TCO) -- consumer grade products will have to be replaced more often
3. Connectivity acceptance and options are normally more available in commercial grade equipment
4. Serviceability of the device
5. Installation friendly options, such as rack mounting
6. Greater environmental adaptability

7. Warranties -- commercial equipment has commercial warranties more appropriate for the application; consumer warranties are often invalidated when the product is used in a commercial application

Content Management Systems

Types of content management for digital signage varies. Displays with no advertising can have loose content management schemes, but displays with advertisements require highly structured management, scheduling and reporting.

Scheduling

Scheduling paradigms differ between CMS platforms, but there are two broad categories of approach. The first is loop-based or strict scheduling. In this approach, users set a hard playlist with a set number of spots per loop covering both advertising and non-advertising content. Campaigns are scheduled either based on a set number of spots per loop or on a frequency of number of plays per hour. The second approach is rules-based scheduling, in which content and advertising are dynamically scheduled based on business rules such as audience criteria, price and more.

Cloud-based Systems vs. On-premise Management

On-premise CMS platforms are ideal for media systems that are managed locally and require high security. A cloud-based CMS is ideal for media systems that are managed remotely, require extensive asset storage and have a fast internet connection on-site or a method to cache content locally to mitigate internet outages.

Vendor vs. Commercial Hardware

Some digital signage system providers recommend or require their hardware be used, instead of commercial hardware. Using vendor hardware can help make a system easier to service, since the system is familiar to the vendor. However, using vendor hardware creates system "lock-in." If a client decides to switch to a different CMS or player, they are forced to purchase new hardware.

Player Requirements

Choosing a player is dependent on which content features you want to support, what resolution you need to run, and if you need frame-syncing between multiple computers. It is important to consider your needs today, but also your future needs, as the cost to replace

hardware can be prohibitive. Investing more upfront can yield long-term savings and allow you great flexibility in adopting new technologies as they arise.

Most hardware available today can handle basic 1080p video, however multi-frame layouts and dynamic content such as HTML5 animations will put more of a strain on the player. Higher resolution content (4K and higher) will need players specifically equipped to handle that resolution.

Live Video Input and Feeds

Internet-based video feeds allow displays to show video from live events in real-time. Physical video inputs can also be used to show live video that is available locally. Video capture cards are often necessary to support this.

Real-Time Content

Real-time content is typically produced using HTML technologies, but can also be developed using CMS-specific SDKs. Not all CMS platforms support real-time, generative content. Real-time content that uses external data requires an internet connection to fetch from web-based APIs.

Frame-Syncing

One media player can typically run one large display or many small displays in sync, but when running many large displays, many players may need to be used, in which case, frame-syncing technologies are necessary to keep players in sync with each other.

Content Scheduling & Ad Serving

Content scheduling can be managed either with a playlist or a rules-based system. Playlist systems are easy to alter and quite intuitive, allowing managers to slot new content into a playlist wherever and whenever they choose. This is well-suited for small networks that do not have complex content delivery needs.

For complex or larger networks, however, it can be incredibly time-consuming to add, remove or edit content within many playlists. For these larger networks, a rules-based system will be preferable. These systems allow network operators to set conditions for when and where content should be played, with content delivery automated by the content management system.

Ad serving almost inevitably adds complexity. Advertisers might want content delivered at particular times of day, may not want their ads to play within the same loop as a competitor or may only want certain ads to be played in response to certain conditions (level of foot traffic in a building, the weather outside, etc.) When working with a number of advertisers, managing these kinds of needs on an ongoing basis is most easily done with a rules-based, automated system.

An ad server is a web-based tool that stores, maintains and delivers advertisements to screens. It is a tool used by publishers to help with campaign management and ad trafficking. An ad server also provides reporting on ads displayed. In programmatic transactions, when an impression is available on a media owner's network, the ad server alerts the supply-side platform (SSP) that an impression is available for a programmatic buy to fill. This notification is then broadcast through an exchange, typically providing additional details of the location and other data about the inventory. Buyers can then bid on the inventory in real-time via a demand-side platform (DSP) that is also plugged into the exchange.

Security

Internet access is extremely important to digital signage networks and needs special consideration in terms of integrating the signals across an organization's existing IT network or building a dedicated one. Redundancy should be addressed, as should backup plans for Internet failure -- the more critical the network is to an organization, the more important the backup plan is. For example, a network that goes down in an airport is obviously a much bigger problem than a single display in a doctor's office waiting room.

Digital signage networks are of interest to hackers and other cyber criminals due to the public nature of the displays and the ability to reach a wide audience. Network operators need to take cybersecurity very seriously.

Nature of Threats

An attacker does not need to gain control of your systems to do damage. They only need to disrupt normal operations. If an attacker gains control of a system they can display whatever they want. Physical security of the display and the accessibility of its ports is also important; security on your player and network will mean nothing if the attacker can simply bypass them and plug their own device directly into the display.

Areas of Concern

Run applications with the minimum amount of privileges required. Disable or remove any "Easter Eggs," or maintenance backdoors. Test for overflow and injection vulnerabilities.

Most systems out of the box are not secure. You will need to perform a full review of services, accounts and software. Remove or disable what is not needed.

All communications should be encrypted by default. Certificates or keys must be used. Each mode of communication has its own unique exposures whether it is wireless, DSL, cable or plain old telephone service.

Lockdown and enclose each component. A lock is only a deterrent. Assume that it will be bypassed. Cases should have no external screws; cables should all be routed internally. Expose only what you must (antennae, touch screens, etc.) Develop automatic fallbacks if any item is compromised. A disabled system is better than a compromised system.

Social engineering is one of the most powerful tools available to a hacker. Put policies in place that ensure that information is only revealed to those who need to know and only through proper channels. Make sure that staff is trained in the policies and that training is a continuous process.

Strategies for Protection

Make security an integral part of your plans from the ground up. Don't rely on a single piece of software or hardware for security. Assume each device is vulnerable to attack. A Virtual Private Network (VPN) does not guarantee network security.. Disable unused ports on your Ethernet switch. Disallow all network cards, except for the MAC addresses you know should be on your network.

Reduce the avenues of attack by removing all applications and services that are not needed.

Remove or disable all guest or system accounts that are not needed. Use strong passwords, change them periodically and do not have one universal password that gives away the keys to the kingdom if compromised. Remove the easy web configuration software on your router.

Prepare a plan for patch management. Ensure you identify all items that could need security patches or firmware updates. Routers, hubs, touch screens. Every day hackers find new ways to wreak havoc. Bring an outside expert to review your security.

Make sure that staff is trained in basic policies and procedures. Only share information with known people outside the company.

Turn on logging and enable monitoring of each system that you can and prepare for off-hour notifications via email, text or pagers.

Managed DNS Services

A managed DNS service queries DNS (Domain Name Service) queries through a secure network of servers around the globe. These systems use threat intelligence to produce real-time perspectives on which websites are safe and which sites are known to include malware or other threats. If the system detects that the site you want to reach is known to be infected, you'll automatically be blocked from entry -- keeping your data and boards safe. While there are different managed DNS services, one of the top-four services in the world is Quad9. Unlike other services that either charge users a fee or sell users' data, Quad9 is highly privatized, free and GDPR-compliant.

Two Factor Authentication

Moving beyond the simple username and password sign in, the industry security standard is two-factor authentication. This capability mitigates certain brute force attacks, by having a user authenticate themselves first through the standard username and password and then either through a randomly generated number provided by a service (e.g., Okta) and authenticating a user through the app or by having their mobile phone tied to the account and receiving a randomly generated number that they then type into the website.

Email Phishing Mitigation

The number one attack surface for cyber criminals is you and your employees. The vast majority of all successful cyberattacks first begin with a phishing campaign. By pretending to be someone else and sending either an attachment that the user downloads or a link that a user clicks on, a cyber-attacker will gain access to a user's network. One of most efficient means to mitigate phishing risks is to make sure that you are adequately protecting your emails with the following protocols: DMARC, SPF and DKIM. One of the easiest ways for you to see if your emails are protected is by going to DMARC here. This site will allow you to put in your email address and tell you whether or not you are protected and if so at which level. If you are not protected, the site will then walk you through the appropriate steps so that you (or your IT administrator) will have the appropriate script to copy and paste into your email server.

Physical Access

Digital signage systems are often physically accessible to the public. Direct access to hardware dramatically increases the susceptibility of digital signage networks to potential

attack. Network owners must take precautions to limit access or block off physical access to ports and inputs on displays and players.

Where to Go for Additional Information

While it can be overwhelming, the NIST Cyber Security Framework is the all inclusive and ever evolving catalog of knowledge when it comes to cybersecurity. More information on data security can be found on the American Institute of Certified Public Accounts' website and on its SSA16 standards [here](#).

Proof of Play

Proof of play (PoP) is the term used to describe the logging of data on media players. Each time a piece of content is played, the player logs the occurrence and stores it, which is then available for use in reporting to verify the advertiser has received what it paid for. The term "proof of play" is often interchanged with "proof of posting" or "proof of performance" that are used within the OOH market.

These logs are used to validate that what was planned to play on a display did (or didn't) play as expected. It's important to note that player logs on their own can't confirm the display was turned on. Without accurate PoP data, it is difficult to accurately measure success; there is a need to cross reference PoP with other data sets such as impressions from cell phone data, computer vision, webcams or screen grabs.

There is currently a working group setting proof of play standards on a global level; it comprises businesses and trade organizations from around the world. This framework is constantly evolving as new technology emerges and these standards have been developed to support that. Below is the first version.

Purpose

The purpose of this framework is to define consistent proof of play (PoP) standards that can be used globally to support advertisers, media owners, publishers, agencies and third parties involved in the digital out of home industry.

The intention is to introduce a vocabulary and definition to avoid confusion when discussing systems and avoid errors when developing or operating proof of play services. The terms, syntax and definition of the data types are defined to facilitate easy and efficient integrations between systems.

The framework defines eight reporting levels, the data required to generate the report, the method of delivery and any supporting data or systems that can provide secondary or tertiary validation. Importantly, it makes the distinction of self-validation or third-party validation; the latter offers a higher degree of trust and transparency for the advertiser.

For a more detailed view of this table, [view the PDF version here](#). This table will continue to be updated; below is the first iteration. To see the latest version, [visit this online document](#) (you must request access).

Proof of play global reporting standards 26 October 2018									
<<<< Self Verification >>>>									
<<<< Independent Verification >>>>									
Reporting Level		1	2	3	4	5	6	7	8
Delivery method	None	Manual, e.g., figures in an email	Manual, e.g., CSV sent by email	Manual, e.g., CSV sent by email	Manual, e.g., CSV sent by email	API	API	API	API
Format	No play-out information provided	Non-standard data and template	Agreed standardised data and template	Agreed standardised data and template	Agreed standardised data and template	XML or JSON via push or pull API	XML or JSON via push or pull API	XML or JSON via push or pull API	XML or JSON via push or pull API
Proof of play data provided	None	Total number of plays by day	Total number plays by day: - Unique Frame Identifier(*) - Date - Hour - Number of Plays - Spot length - Share of Time	Total number plays by day & hour: - Unique Frame Identifier(*) - Creative ID - Start Date - Start Time - End Date - End Time - Number of Plays - Spot length - Share of Time	Total number of plays by day & hour: - Unique Frame Identifier(*) - Creative ID - Start Date - Start Time - End Date - End Time - Number of Plays - Spot length - Share of Time	All individual play outs: - Unique Frame Identifier(*) - Creative ID - Start Date - Start Time - End Date - End Time - Spot length	All individual play outs: - Unique Frame Identifier(*) - Creative ID - Error codes - Start Date - Start Time - End Date - End Time - Spot length	All individual play outs: - Unique Frame Identifier(*) - Creative ID - Dynamic ID - Error codes - Start Date - Start Time - End Date - End Time - Spot length	All individual play outs: - Unique Frame Identifier(*) - Creative ID - Dynamic ID - Error codes - Start Date - Start Time - End Date - End Time - Spot length - Custom report data validation
Delivery lead time	None	Within 1 week of campaign end date	Within 1 week of campaign end date	Within 24 hrs of campaign end date	Morning after each day of the campaign	Within 1 minute of play	Within 1 minute of play	Within 1 minute of play or faster	Within 1 minute of play or faster
Computer Vision	None	Optional	Optional	Optional	Suggested	Suggested	Suggested	Required	Required
Pixel Tracking (is the screen on, device health?)	None	Required	Required	Required	Required	Required	Required	Required	Required
Verification of display (e.g., webcam grabs)	None	Optional	Optional	Optional	Suggested	Suggested	Required	Required	Required
Mobile data	None	Optional	Optional	Optional	Suggested	Suggested	Required	Required	Required
3rd party impression tracking pixel									
Archiving of data MO side, duration	None	3 months	6 months	1 year	1 year	2 years	2 years	2 years	2 years

(*) Unique Frame Identifier refers to a unique ID required to identify the specific panel where the ad was displayed.

Vocabulary & Definitions

Term	Definition
Self verification (SV)	Self verification is when the media owner or publisher provides the PoP reports without a third party verifying they are accurate.
Independent verification (IV)	Independent verification is when the PoP reports are verified as accurate by a third party.
Campaign	The advertising campaign that the PoP report relates to. This is often referenced in different ways by different stakeholders; further definition is required.
Level (0-8)	The numeric value on a scale of zero to eight that defines what data is included in the PoP report. The higher the number, the more detail the report will provide.
Proof of play data provided	The agreed data provided from each format PoP report to reach the “level” of report.

Term	Definition
Format	The name of the media format that the PoP data is being provided from; this could be a single display or a network.
Delivery method	The way or format the PoP data is delivered, e.g., CSV, Excel, PDF, XML, JSON, API.
Delivery lead time (time)	The amount of time a media owner or publisher takes to deliver the PoP report to a system or individual.
Computer Vision (CV)	The use of image recognition software to count the number of times people looked at the campaign content.
Screen heartbeat (HB)	A system that polls the display at regular intervals to confirm that it is turned on.
Verification of display (VD)	Access to a live webcam or display grabs to show what content was or is displaying on display.
Mobile impression data (MID)	A service or system that provides information on the number of people within a defined demographic who have come within a defined proximity of the display. Typically referred to as “impressions” and represented by a number in the report.
Third-party impression tracking pixel	
Archiving of playout data	The amount of time that the PoP data will be available from the media owner or publishers platform.

Data Schema & Syntax

Terms	Syntax example	Definition
PanelId	Alphanum	Unique Frame Identifier refers to a unique ID required to identify the specific panel where the ad was displayed.
StartDateTime	yyyy-MM-dd HH:mm:ss+/-UTCHH:mm:ss 2018-01-04T12:54:35.916+02:00	Start date and time of reported playout in ISO8601 for date-time in UTC format.
EndDateTime	yyyy-MM-dd HH:mm:ss 2018-01-04T12:54:35.916+02:00	End date and time of reported playout in ISO8601 for date-time in UTC format.
CreativeId	Alphanum	Unique identifier per campaign that indicates the creative displayed.

Terms	Syntax example	Definition
DynamicId	Alphanum	Unique identifier per campaign that indicates the exact asset displayed.
Number of Plays	Integer	Total number of times a creative played by a specific period of time.
Spot Length	Integer	The number of seconds a creative is supposed to be displayed per loop.
Error codes	Alphanum	Codes that relates to errors when communicating with APIs.
OrderId	Alphanum	Sales Order Identifier

Reporting Level Convention

It is recognized that the different stakeholders will be able to achieve different levels of reporting and supply additional supporting data. The following describes how to define what reporting level has been achieved for any format using specific definitions from the framework and what supporting data is available.

Refer to vocabulary and definitions table for detail.

Convention longhand

Level_VerificationType_LeadTime_ComputerVision-ScreenHeartbeat-VerificationDisplay-MobileImpressionData

Convention shorthand

8_IV_RT_CV-SH-VD-MID

Support & Service

Ensure your display provider has revision traceability for both the software and hardware when a new display is deployed this ensure you have a known starting state. Once you have your display system in place, over time there will likely be software updates that can be driven by multiple factors such as innovations, end of life components, operating system, security patches, etc. These notices are typically external drivers that you may receive as a notification from your supplier.

Implementation, a checklist to verify the execution of software and hardware changes should be used to ensure functionality is as expected as well as include steps to ensure any areas of vulnerability are reviewed such as verification of disabled unused ports.

Recording changes, a change log for tracking purposes should be generic in terms of type of update to the display system will serve you well for tracking over the longevity of the display life. Last step would be to log the implementation with; change description, date, revision and identification of person applying the change. Save the change log data in a secure location that is backed up as well as only shared with known people.

Training staff with respect to the policies and software and hardware update procedures should be completed upon display system installation. Scheduled ongoing training should be planned to address personnel and policy changes.

ABOUT THE DOOH PRIMER

This project was compiled using a combination of original writing and sections taken from over 400 pages of documents owned and originally produced by the five industry associations that came together to produce the project. All sources were used with permission from the five associations.

ABOUT THE DIGITAL SIGNAGE FEDERATION (DSF)

DSF's Mission is to support and promote the common business interests of the world-wide digital signage, interactive technologies and the digital out of home network industries. The DSF is a not-for-profit independent voice of the digital signage industry reflecting the diversity of its membership. It promotes professional recognition through certifications, continuing education, conferences, publications, and presentations offered by the DSF and affiliate groups. It provides advocacy by leveraging the collective strength of members and represent their interests at the higher levels of government and the community. The DSF provides leadership and networking opportunities focused on building a strong foundation for the advancement of the digital signage industry.

For more information, please visit digitalsignagefederation.org.

ABOUT THE DIGITAL PLACE BASED ADVERTISING ASSOCIATION (DP-AA)

The Digital Place Based Advertising Association (DPAA) leads the Digital Out of Home (DOOH) industry as marketing to consumers *outside* the home is experiencing aggressive growth versus advertising *inside* the home, which is continuing its fragmented decline.

DPAA fosters collaboration between advertisers, agencies, ad-tech, mobile companies, location data, software, hardware and others while providing guidelines, standards, best practices and industry-wide research all promoting the effectiveness of digital place based advertising.

For more information, please visit dp-aa.org.

ABOUT GEOPATH

Founded in 1933, Geopath is the industry standard that powers a smarter OOH marketplace through state-of-the-art audience location measurement, deep insights and innovative market research. The organization is headquartered in New York and governed by a tripartite board composed of advertisers, agencies and media companies spanning the entire United States.

For more information, please visit geopath.org.

ABOUT THE INTERACTIVE ADVERTISING BUREAU (IAB)

The Interactive Advertising Bureau (IAB) empowers the media and marketing industries to thrive in the digital economy. Its membership is comprised of more than 650 leading media and technology companies that are responsible for selling, delivering, and optimizing digital advertising or marketing

campaigns. The trade group fields critical research on interactive advertising, while also educating brands, agencies, and the wider business community on the importance of digital marketing. In affiliation with the IAB Tech Lab, it develops technical standards and best practices. IAB and the IAB Education Foundation are committed to professional development and elevating the knowledge, skills, expertise, and diversity of the workforce across the industry.

For more information, please visit iab.com.

ABOUT THE OUT OF HOME ADVERTISING ASSOCIATION OF AMERICA (OAAA)

The Out of Home Advertising Association of America (OAAA) is the national trade association for the \$7.8 billion US out of home (OOH) advertising industry, which includes digital out of home (DOOH), and is comprised of billboards, street furniture, transit advertising, and place-based media.

Comprised of 800+ member media companies, advertisers, agencies, ad-tech providers, and suppliers that represent over 90 percent of the industry, OAAA is a unified voice, an authoritative thought leader, and a passionate advocate that protects, unites, and advances OOH advertising in the United States.

For more information, please visit oaaa.org.

ABOUT THE RAVE AGENCY

Founded in 1998, THE rAve Agency, co-owned by Gary Kayye and Sara Abrons, is a creative agency focused on B2B technology markets, particularly the audiovisual and digital signage industries. It offers consulting and creative services such as marketing strategy, market research, speaking, social media marketing and more. Gary Kayye has been an assistant professor at the UNC School of Media and Journalism, focused on advertising and new media, since 2009.

For more information, please visit THErAveAgency.com.

