Digital Signage & the Internet of Things

Digital displays are no longer the passive carriers of content. IoT devices are allowing displays to make content decisions in real time, while providing deployers with a treasure trove of data.

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INTRODUCTION

Digital signage has long been recognized for its ability to attract and engage viewers. The benefits of digital signage are obvious, and many. Digital displays allow for bright, full-motion video that captures the attention of passers-by. Its networking capabilities allow users to update content at a moment’s notice from a central location, letting deployers test different messages across a variety of deployments and gauge the effectiveness of each based on how it affects customer behavior. Those same networking capabilities eliminate the printing and mailing costs associated with static signage and ensure that content is in front of its intended audience and not sitting in a box in the corner of a manager’s office collecting dust.

A recent report from Grand View Research predicts the size of the global digital signage market will reach $31.7 billion by 2025, an 8% compound annual growth rate compared with where it stands today, driven by increasing demand from industries including retail, healthcare, transportation, finance and manufacturing. The Grand View study estimates that 6.5 million display units will ship in 2025 compared with 3.5 million in 2018. New technologies are expected to allow for increased screen sizes, sharper resolution and lower energy consumption.

But while display technology allows for the quick and easy dissemination of new content, most digital signage has traditionally been passive. Dynamic, full-motion video can attract eyeballs, but in most cases it isn’t able to sense and react to those eyeballs. It doesn’t know if it’s raining outside, if it’s warm or cold, or whether the person viewing that content is male or female, a high-school aged shopper or a senior citizen. But that’s changing.

The emergence of the Internet of Things (IoT) promises to dramatically expand the power of digital signage. IoT devices allow digital displays to reacted to any number of external triggers, showing the right content at the right time to the right audience. In addition, IoT devices provide deployers with a firehose of data they can use to improve operations and content effectiveness.

Still, without the right tools leveraging the power of the IoT/digital display combination can be a nearly impossible task.
A look at the technology

In its relatively brief history, digital signage has become one of the dominant forms of messaging in the marketplace.

Although there haven’t been many in-depth studies of the effectiveness of digital signage in recent years, there are plenty of statistics that demonstrate its power. In the retail world, digital signage has a recall rate of 83% and nearly 80% of customers say they entered a store because a digital display caught their interest. In fast-casual and QSR restaurants, digital signage helps shorten perceived wait time, with 29.5% of customers saying digital menus influenced their purchasing decisions. In health care, 75% of those viewing a digital sign in the hospital could recall at least one message they saw.

Similar results have been found in other verticals as well. In many of those examples, though, the signage in question simply displayed messaging on a loop, not influenced by the people viewing the signage or the specific conditions of the environment where the displays were located.

It stands to reason, then, that if deployers could find a way to target messages displayed on digital signage based on external factors occurring at the time or targeted to the demographics of the viewer, the power of digital signage would be enhanced. The Internet of Things is making that possible.

Signage with a brain

The term “The Internet of Things” was first used by Kevin Ashton, co-founder of the Auto-ID Lab at the Massachusetts Institute of Technology, in a presentation to Proctor & Gamble in 1999 about the use of radio frequency identification in supply chain management.

“In the twentieth century, computers were brains without senses—they only knew what we told them,” Ashton said in a 2015 interview published in Smithsonian Magazine.
“That was a huge limitation: there is many billion times more information in the world than people could possibly type in through a keyboard or scan with a barcode,” he said. “In the twenty-first century, because of the Internet of Things, computers can sense things for themselves.”

Definitions vary, but according to Wikipedia the Internet of Things is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

The Internet of Things has evolved since 1999 thanks to the development of new technologies, real-time analytics, machine learning and more.

When it comes to digital signage, combining displays with IoT devices results in digital signage that:

• Responds to changes in conditions.
• Is affected by other systems, sensors and data sources.
• Is sensitive to surroundings.

Some of the most common IoT devices in use today include:

• Beacons that communicate with a person’s smartphone. A shopper, for example, might have a store’s app on their phone. That app might provide digital displays about the shopper’s purchase history, allowing for messaging such as, “Last time you visited you purchased a pair of slacks. Here are some shoe selections that would match those slacks perfectly.” Those apps might also provide information about an upcoming birthday or anniversary, prompting the display of content to suggest purchases for those events.

• Thermometers that can trigger the display of content based on the current temperature. A fast-casual restaurant, for example, might display content promoting a hot soup and sandwich combination when the temperature drops below 40 degrees, or ads for ice cream when the mercury approaches 90.

• Cameras that work with analytics software to determine basic demographic information about the viewer. That allows deployers to show content appropriate for a group of teenage girls or for a middle-aged male depending on the characteristics of the audience.

• GPS sensors mounted on public transportation vehicles that communicate with digital displays in bus shelters or subway stations, alerting passengers to their impending arrival.

• Outside data sources such as point-of-sale systems or back-office systems. Digital menu boards in a restaurant could automatically remove a menu item if stocks are running low or trigger a promotion on a certain item if there’s an oversupply. In a sales office, displays can show a countdown to sales goals in real time and display a congratulatory message when targets are hit. On a college campus, health care facility or government facility, screens can automatically show emergency messaging directing viewers to safe spaces in the event of inclement weather or other situations where lives can be at risk.

These are just a few of the ways IoT devices can magnify the power of digital displays.
How is the Internet of Things affecting digital signage?

IoT is rapidly shifting the world of digital signage from a deployment, content, and management perspective. Institutions accustomed to manual content deployment via files and physical media are now seeing the benefits of the cloud infrastructure and platforms. These benefits include less downtime due to issues and cost savings. From the point that a signage player is ordered to the moment it is installed, every aspect of the digital signage workflow can be done remotely without physical access to the device. Signage can be managed from anywhere in the world that has access to the internet.

—Delix Alex, Technology Manager of Enterprise Platforms at Crestron, a leader in home and office automation

The Internet of Things has enabled rich insights for many types of platforms. Digital signage has been a recipient of these benefits via multiple types of sensors (including cameras), cloud connectivity, machine to machine communication and more that allow the digital signage to be hyper-personalized for the individuals or groups engaging with the digital signage. Being able to adapt to the individual, group or the situation of how the individuals or group are engaging is critical is maximizing the value of the engagement.

—Michael Knight, Global CTO of Industry IoT, Surveillance and Computer Vision at Dell Technologies
How Industries Benefit from the IoT/Digital Signage Combination

One of the main areas where the combination of IoT and digital signage truly shines is in retail. That’s no surprise. A number of studies have shown that the use of digital signage in a retail setting can help boost sales by anywhere from a few percent to 50% or more.

“In consumer retail environments, the growing trend is for a more personalized and emotionally connected experience,” said Trey Courtney, Chief Product & Partnerships Officer with Mood Media. The company is an international provider of music, digital signage, hold music, on-hold messaging, scent, integrated audio/video, and interactive mobile marketing solutions.

“The days of promoting to the masses via hanging print banners or cardboard cutouts is over,” Courtney said. “The leap to digital is happening at an exponential rate and retailers are looking for new, creative avenues to positively enhance the customer experience.”

Courtney broke it down into more detail:

**Retail-Big Box:** Brands in this industry are exploring new ways to better emotionally connect with consumers. They are leveraging new IoT solutions which include strategic placement of digital signage solutions in areas that were once cluttered with print signage as well as introducing new touchscreen interactive solutions for both the consumers and back-of-house for employees. This gives brands new customer touch points that once did not exist.

**Retail-Grocery:** It’s all about shelf space in grocery stores. Screens and new IoT technologies cannot take up large amounts of shelf space, if any at all, as space for products equates to revenue to the grocer. Creative solutions, such as smart digital shelving screens, are being
introduced into strategic areas of the shopper’s journey. Digital is providing new avenues to easily update content and quickly change promotions, while utilizing creative video messaging to capture the attention of shoppers.

Smart digital shelving units allow for data to be captured in high traffic places, such as end caps or specific departments.

**Retail-Specialty**: For specialty retailers, the trend is all about telling the brand story. This can be executed through the use of lift and learn technology, which allows for hands-on consumer connections to products. For example, when a consumer wants to become more educated on a product such as performance or best-use applications. They can physically touch and lift the product in the store, triggering video content relaying specific product features.

Not far behind is the restaurant industry, where the use of digital menu boards has grown dramatically. Examples include:

**QSR/Fast Casual**: IoT being used on digital signage has multiple touchpoints in the QSR/Fast Casual industry. The first customer touchpoint in this industry is entryway promo boards, which allow customers to engage in dynamic content that properly communicates to patrons at appropriate times. With digital menu boards, using camera technology to track how customer’s eyes move across the menu allows marketing teams to better position creative assets and ensure high-margin items are being viewed.

And although retail and restaurants are two of the largest uses of digital signage, there are others that show similar potential:

**Healthcare**: Healthcare companies are increasingly using digital signage solutions to enhance patient waiting rooms. Video solutions, utilizing small media devices connected to the internet, allow for a truly customizable television-like experience. Healthcare companies are creating their own TV networks with best-in-class partnerships, allowing them the new ability to immediately enhance the customer waiting experience.

**Financial services**: In-branch displays can update interest rates and other financial information in real-time, ensuring customers have the most accurate information possible. In addition, video analytics cameras can gather basic demographic information about those customers and display appropriate content. Twenty-somethings, for example, might be presented with information about financial planning, home mortgages and long-term savings programs, while older folks might see content related to retirement planning.

**Transportation**: Sensors mounted in buses or other transportation vehicles can communicate with digital signage in transportation hubs or bus stops, alerting travelers to arrival and departure times, delays or even impending inclement weather. U.K.-bus company Lothian, for example, leveraged the Pelion Connectivity Management solution developed by Cambridge, UK-based technology firm Arm to remotely update destination screens with route information and keep abreast of any incidents with the 700-vehicle Lothian fleet. Reliable 4G connectivity enables both bus and social media feeds to be updated in real time, helping Lothian’s customers to stay up to date regarding the status of their service.
Outdoor advertising: Digital billboards are quickly replacing the poster-style advertising that has long been a feature of America’s roadways. In addition to being brighter and more visually captivating, those billboards can run multiple messages and can be updated remotely.

“Over the years we’ve added smart features like webcams for proof of performance, signs that can report status and diagnose service issues automatically and a [network operations center] designed around monitoring health reports,” said Kyle Dines, Watchfire’s Vice President, Sports & Indoor.

“Today our on-premise and indoor digital signs also make use of IoT technology and can display conditional content based on factors like weather, high/low tide or market conditions,” Dines said. “Integration with social media and other online data sources make messages timely and targeted. RSS feeds, pricing/inventory systems and social media are among the most common IoT integrations.”

IoT in Retail Market to Top $35 billion by 2024

The expansion of IoT in retail has revolutionized the sector, and the trend is predicted to continue for the next several years.

Smart supermarket shelves, for example, are being equipped with RFID to display personalized advertisements and electronic labels designed to increase sales. For instance, an American retail giant recently deployed a cloud-based display solution for its store shelves that display advertisements, nutritional data, prices, videos and coupons. Customers can instantly compare nutritional information between the brands of products and scan coupons with their phones.

IoT in retail market is carving out new growth scopes for itself with such technologies as IoT sensors, which can be used in supermarkets for temperature maintenance. IoT sensors can be fitted into freezers to check temperatures to make sure they are appropriate, collect data from smart shelves and transmit it to store associates for analysis and help in understanding which products appeal to consumers so that stores can arrange items on display accordingly.

Source: Global Market Insights
Certainly, combining digital signage with IoT devices can create a more targeted, personalized experience for the viewer. But the benefits don’t stop there.

In addition to triggering targeted content, IoT devices create a record that can be compared with other data sources in an operation. The result is a virtual firehose of information that an operator can use to improve business operations.

“If I change the image on a display and keep track of how many people go by, what percentage interact with it and how long they interact, it’s similar to search engine optimization in a digital signage environment,” said Scott Nelson, VP of Product at Digi International, an industrial Internet of Things technology company headquartered in Hopkins, Minnesota.

“And if you’re in a retail store, you can use the data you’re gathering to know the type of person who’s in the store to display content they want to see,” Nelson said, “I’m going to make sure they know a product they might be interested in buying, for example, is on sale.”

The amount of data being created by each customer engagement with a digital sign is massive, said Michael Knight, Global CTO of Industry IoT, Surveillance and Computer Vision at Dell Technologies, providing a tremendous opportunity to personalize the customer engagement.

“This data can be highly refined using machine learning,” Knight said. “Weather, noise, demographics, past engagement outcomes and other criteria further enables the digital signage to better connect with the engaged audiences.”

In fact, analytics is key to determining the success or failure of the integration of IoT and digital signage, said Mood Media’s Trey Courtney. The data gathered can include details about age, gender and even which emotional state the customer is feeling when viewing specific products. This data can then be applied to operational or marketing initiatives to enhance the customer’s experience by providing more relevant and targeted messaging and product.
“Retailers are now able to better identify key shopping habits that were once unobtainable,” Courtney said. “From acknowledging where customers look on digital menu boards or grocery-retail digital shelving units to better understanding the demographics interested in a given product, [the technology] allows retailers to better position products customers want while avoiding the clutter of non-applicable offers.”

**The data management challenge**

To get a sense of how companies were addressing the issue of data management, in July 2018 technology provider Arm commissioned Forrester Consulting to explore IoT use cases in the manufacturing, transportation and consumer packaged goods sectors.

One of the key insights stemming from the project was that many organizations were lacking when it comes to the technological challenge of deriving actionable insight from the data IoT projects delivered. With billions of devices being connected in the IoT, even companies well versed in data collection have struggled to effectively overcome data silos and data preparation issues to leverage the insight such data can provide.

Forrester surveyed 150 organizations across the United States with more than 5,000 employees. Each respondent stated that they either influenced decisions, was part of a team making decisions, or was the final decision maker for their organization’s data and analytics strategy and technology buying decisions. Of those, 83% said they were ready to move their IoT projects from pilot phase to full-scale implementation.

However, those organizations acknowledged they needed to master the data management issues they faced before they can harness the insights that IoT can provide. Nearly two-thirds noted that data collection, management, and/or governance was their top challenge when implementing IoT solutions. More than half recognize that their back-end technology is not robust enough to truly scale these solutions.

When asked about what specifically challenges them with IoT data management, respondents selected silos, preparation and integration as their top challenges. Just 19% cited collection as a challenge. Instead, companies recognize that data management is the foundation for successful IoT deployments and realize that they must create a solid base upon which to build their IoT solutions.

The takeaway? The results of the Forrester study suggest nine out of 10 companies are looking to partner with external vendors to assist with implementing their IoT projects. For deployers, the challenge then becomes finding the right partner to make their project a success.

**Creating the 360-degree view**

According to the Forrester study, two thirds of the organizations surveyed said IoT would be a focus of their investment over the next year. Organizations will be focused on:

- accelerating their digital business;
- improving insights through data; and
- addressing rising customer expectations — all while reducing costs and growing revenue.

When asked about their top priorities for the next year, 42% of organizations stated that addressing rising customer expectations was a top initiative. To that end, 61% of respondents noted that IoT solutions have helped them improve their customers’ experiences.

Similarly, 44% of organizations were looking to reduce costs as a top business priority in the next 12 months; 46% recognized that their IoT solutions have helped them reduce operational cost at their companies.

*Source: Arm*
Managing IoT Devices

More than two-thirds of the organizations responding to the aforementioned Forrester survey noted that they plan on increasing the number of IoT sensors they deploy. And more than 60% of respondents indicated that IoT has fundamentally transformed their business models.

Although the experiences those devices help deliver and the data they provide is helping to drive that transformation, the lifeblood of any IoT/digital signage project is connectivity.

And as has been the case with digital signage, more and more IoT devices are relying on cellular connectivity to deliver their value proposition, allowing deployers to place devices anywhere there is a power source without the need to connect to a local wireless or hard-wired network.

Cellular service is secure and reliable, and the infrastructure is already in place. Most cellular providers today offer peak download speeds of close to 300 Mbps or greater via their 4G/LTE networks, as good or better as what many cable Internet providers offer. And with the coming 5G service, carriers are promising speeds of close to 10 Gbps.

But managing hundreds or thousands of cellular-based IoT devices can be a complicated task, made even more challenging if the deployer operates across a wide geographic area. That can mean dealing with multiple vendors. In addition, traditional cellular connectivity methods typically require different subscriber identity modules, or SIM cards, for each vendor, meaning the manufacturers of IoT devices need to have on hand multiple SIM card to accommodate different vendors for different locations. Changing service providers would likely require having a technician physically visit the site to either swap SIM cards or change the entire device.

Fortunately, the challenges and costs of dealing with multiple SIMs and multiple vendors can be overcome via a process known as Remote SIM Provisioning. Remote SIM Provisioning provides users with the ability to change SIM profiles over the air, without having to change the SIM card that is inserted into a device.
Remote SIM Provisioning opens the door to a range of use cases that cannot be supported by conventional SIMs. For example, Remote SIM Provisioning allows a device manufacturer to insert or embed a reprogrammable embedded SIM, or eSIM, into their devices at the point of assembly. When the device is turned on, provided the correct configuration is in place, it can connect to a local cellular network, making the device ready to use immediately regardless of the location where it has been deployed.

Remote SIM Provisioning is particularly beneficial for organizations with large-scale, or geographically diverse digital signage deployments, because it allows profiles to be changed without the need to conduct a site visit. If the service operator that an organization is using experiences an outage, Remote SIM Provisioning allow the organization to switch to another profile and minimize any downtime.

What does all this mean for the combination of digital signage and IoT devices? Ultimately, it means that deployers can include IoT devices with virtually any screen in their network no matter where they may be located. The end result will be a network that delivers a truly personalized experience for the consumer.

The Pelion Connectivity Management solution

One of the ways retail device manufacturers can take advantage of Remote SIM Provisioning is via Pelion Connectivity Management, part of the IoT platform developed by Arm.

Arm’s Pelion Connectivity Management offering for Remote SIM Provisioning comprises of two key elements. The first is the wide range of eSIM profiles which Pelion Connectivity Management provides to subscribers. The second is the ability to orchestrate eSIM profiles across an entire fleet of devices using a single application. Through these two elements Pelion Connectivity Management’s service set for Remote SIM Provisioning allows clients to deploy a single solution that delivers local connectivity rates on a global basis.

Pelion Connectivity Management has developed international connectivity partnerships with more than 600 operators. Through its network of operator integrations, Pelion can provide enterprise clients with a vast selection of eSIM profiles. All eSIM profiles can be managed using Pelion Connectivity Management, irrespective of mobile network operators.

This means that customers can perform all the activities associated with Remote SIM Provisioning and connectivity management from a single application. Connectivity Management allows customers to perform activities such as remotely provisioning eSIM profiles, checking uptime and performance of devices remotely, checking bills and invoices, setting up data routing feeds and generating connectivity reports.

With network and SIM manufacturer agreements already in place, Pelion Connectivity Management simplifies the process of implementing eSIM profile orchestration and allows clients to bypass the disruption of integrating with multiple third parties. Through its extensive suite of connectivity management and profile orchestration functionality, it enables clients to get started with Remote SIM Provisioning as quickly as possible.
It's rare to participate in a discussion about the future of digital signage without a mention of the 2002 Tom Cruise film Minority Report, where digital displays recognize passers-by and call out to them by name, referencing past product purchases and other personal information.

Although we may never achieve that level of sophistication, it’s clear that partnering digital signage and IoT can dramatically increase the power of that signage by delivering the messages viewers need to see when they need to see them. Content will no longer depend on a preprogrammed playlist. Instead, it will depend on the person viewing the screen and the environment in which that screen is placed.

In the not-too-distant future, digital signage systems will be able to target messages to specific displays based on the data they are receiving and analyzing. Systems will be able to sift through enormous amounts of information to decide what content should be displayed where, and when. The backbone of those systems will be the connectivity making possible that flow of information.

Combining digital signage with IoT devices can be a daunting task, but it doesn't have to be. All it takes is the right management solution.
**About the sponsor:** Arm technology is at the heart of a computing and connectivity revolution that is transforming the way people live and businesses operate. Arm’s advanced, energy-efficient processor designs have enabled intelligent computing in more than 130 billion chips. More than 70% of the world’s population are using Arm technology, which is securely powering products from the sensor to the smartphone to the supercomputer. This technology combined with IoT software and end-to-end connectivity, device and data management platform enables customers to derive real business value from their connected devices and data.

In order to create better customer experiences, retailers are looking for flexible solutions that take the complexity out of connecting devices to the IoT without compromising security. Having the freedom to conduct business anywhere at any time and being able to quickly meet demand is vital to stay competitive.

By leveraging cellular connections, devices such as kiosks, point of sale and digital signage, to name a few, can rely on an extensive existing network to ensure a continuous service out of the box. With so many devices deployed across multiple sites, being able to manage these remotely and deploy at short notice is of huge value.

In addition to being flexible to deploy anywhere, anytime, connected devices can provide operational data from remote locations including the ability to manage stock inventory from multiple deployments at once, update digital signage at the touch of a button, and see your connected devices are running at optimal.

Pelion Connectivity Management offers a simple solution to the complexity of IoT connectivity.

**One global roaming SIM:** Freely move assets as required with no need to physically change a SIM card or enter new operator agreements.

**One global contract:** Use a single contract for global connectivity and competitive tariffs protected by Arm’s Platform Security Architecture (PSA) – the guide to born-secure IoT devices.

**Fully managed service:** Out-of-the-box connectivity with automatic authentication, provisioning and connection means new terminals can be up and running within minutes, and with a dedicated team who are on hand to support.

To learn more about Arm Pelion Connectivity Management visit [www.arm.com/connectivity](http://www.arm.com/connectivity) or contact us at PelionCM@arm.com.