Digital Signage Gets Smart

Transforming the Selling Power of Digital Signs

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April 2011

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Executive Summary

Digital technology is turning the traditional practices in signage upside down. Hosting on media such as advertising billboards and poster sites, kiosks and point-of-sale (PoS) terminals is giving way to a first wave of digital signage.

Displaying advertisements on large monitors instead of on printed posters was aimed at reducing the cost of changing messages and at bringing an element of movement and sound to out-of-home advertising. But the essential architecture of the digital signage system mimicked that of the old technology: just like the printed page, the electronic display was viewed as a dumb terminal and was intended to be viewed, not used, by the consumer.

Now, the pieces of the technology puzzle have come together to enable a more dynamic and interactive replacement for ink-on-paper signs: driving a new wave of digital signage. Consumers benefit from more relevant and engaging promotional content. Marketers can engage with relevant consumer groups more effectively, more of the time; and measure that effectiveness in ways that were not possible with traditional signage and are not even currently possible with online marketing tools.

Equipment manufacturers face a fast-growing market with a massive variety of digital signage equipment that is not dominated by large suppliers. The challenge for original equipment manufacturers (OEMs) is to develop and modify products quickly in response to a wide variety of customer demands and user environments.

This eBook, which is aimed primarily at OEMs, describes the impact that the new technology is having on the ways that digital signage is used. It also offers a guide to a technology architecture for digital signage, based on Intel® embedded technology implemented by Emerson Network Power. This architecture enables OEMs to rapidly and cost-effectively develop high-performance digital signage products, and to re-use and modify both hardware and software components in multiple variants of platform products.

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Signage Revolution (Page 1)

Digital technology is turning the traditional practices in signage – hosted on media such as advertising billboards and poster sites, kiosks and point-of-sale (PoS) terminals – upside down. For centuries, signage was a fixed, static medium. Signs in the past were printed on paper or painted on to durable surfaces and once installed, they could not easily or cheaply be changed or removed. And to consumers who have grown up with Hollywood or Bollywood and ubiquitous TV, this silent, static medium was uninvolving and easily ignored.

A first wave of digital signage, in which advertisements were displayed on large monitors instead of on printed posters, was aimed at reducing the cost of changing messages and at bringing an element of movement and sound to out-of-home advertising. But the essential architecture of the digital signage system mimicked that of the old technology. Just like the printed page, the electronic display was viewed as a dumb terminal; a central server downloaded content that was common to all terminals. The display was intended to be viewed, not used, by the consumer.

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Signage Revolution (Page 2)

Now, the pieces of the technology puzzle have come together to enable a more dynamic and interactive replacement for ink-on-paper signs:

- The price of thin, flat monitors has fallen fast, while high-definition video supports the deployment of the larger panel sizes now available
- The emergence of multi-core processors enables dramatic increases in the number of compute instructions able to be handled by signage terminals, at the same time as increasing power efficiency. This supports the use of sophisticated applications such as viewer recognition and communication with mobile devices.
- Sophisticated touch controllers allow displays to function as an interactive user interface, without the need for a mouse or keyboard
- Wired and wireless networking technology enables ultra-fast transmission of advertising messages, transactions and analytics between terminals, content servers and enterprise management systems

Local, distributed intelligence at the level of the digital terminal is therefore driving this new wave of digital signage. The market is beginning to see a new generation of digital signage terminals that are:

- Interactive
- Location-aware
- Able to sense and react to characteristics of the user, such as gender and age
- Connected to the Internet
- Capable of processing financial transactions
- Capable of displaying real-time information and streamed content
- Remotely controlled and managed
- Able to connect to electronic devices controlled by the viewer

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Benefits, Opportunities and Challenges

These changes bring wide-ranging benefits, not the least for consumers, who experience more relevant and engaging promotional content. Digital signage is an example of marketing doing the job it is meant to do – connecting customers efficiently with the products and services they value.

And for marketers, digital signage provides the ability to display promotional messages to relevant consumer groups more effectively, more of the time; and to track in a granular way the number of people who viewed a message, their characteristics (such as gender, age) and the length of time they viewed the message – data that is not available at a granular level to TV or Web advertisers, for instance.

Crucially, digital signage allows the delivery of powerful, engaging promotional messages close to the point of sale – in malls, or inside a store, even at the point of sale itself. Consumer goods companies prize the 'moment of truth' when the consumer first starts scanning a shop's displays – digital signage can reach the consumer at exactly that moment.

The promise of digital signage is being reflected in commercial growth: both the numbers of digital signage equipment installations, and the promotional spend on digital promotions by marketers, are growing. International market research firm NSR expects the number of digital signage sites supported by third-party advertising to grow from 596,000 in 2009 to approximately 1.45 million by 2019. At the same time, it expects advertising revenues in digital signage to grow from $1.68 billion in 2009 to more than $7 billion by 2019.

For equipment manufacturers, this is a huge and exciting business opportunity – and not just because the market is growing fast. It is also because the market for digital signage equipment is open, and not dominated by a small number of giant suppliers. In addition, digital signage is not a single, homogeneous application – there are hundreds of varieties of digital signage equipment.

The challenge for OEMs is to develop and modify products quickly in response to a wide variety of customer demands and user environments. There is also a market for companies that can help operators to install and implement technically complex equipment quickly.

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Technology in Action: The State-of-the-Art in Digital Signage

The following scenario could take place in a department store near you – all the technology for it exists and is ready to be implemented today.

A middle-aged, female shopper walks through the main entrance and towards dual 2m x 1m display panels sited a few paces inside the store. As she approaches, a small USB camera embedded in the bevel at the top of the clear-glass panel scans her, immediately discerning her gender and height. A computer embedded in the panel housing then streams an advertisement, aimed at adult female shoppers, to the panel next to it, a 1080p high-definition video monitor. Showing the latest female fashions in rich, pin-sharp colour and stereo sound, the ad makes our shopper's mind up: she will head first for the fashion department. Vivid and targeted, the advertising is tuned for the consumer of today, so adept at filtering out general advertising, but still attracted by messages that appeal directly and relevantly to her needs or desires.

Image source: Intel

While the ad is showing, the clear glass panel displays a menu of choices, such as 'Outdoor wear,' 'Fashion,' 'Sportswear,' 'Lingerie' and so on, with an invitation to the viewer to select. The panel uses sophisticated touchscreen technology, providing an intuitive interface familiar to consumers from other devices such as smartphones and payment terminals.

View demo video on YouTube

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The Future of Retail

Image source: Intel

Our shopper touches the screen on the word 'Fashion,' and images of the latest merchandise appear to float in the air, while the shop itself is clearly visible through the glass, creating an 'augmented reality' effect. The viewer touches the words 'Mobile Coupon' on the clear glass panel. A Near Field Communication (NFC) chip in the panel has recognized that the viewer is carrying a mobile phone, and it now downloads to it via SMS a barcode coupon giving the shopper a beauty products gift with purchases over $200, if the voucher is redeemed in the shop on the same day. The panel, which is connected via a high-speed Gigabit Ethernet link to the store's Enterprise Management systems, has already registered the barcode so that it will be recognized by any of the store's point-of-sale (PoS) terminals.

The shopper then touches 'Floor Plan' on the screen's menu, and the display marks out the path on a 3D map from the panel to the fashion department. Barely ten seconds after walking through the entrance, the shopper is ready to make her first purchase of a newly introduced, high-margin item. The panel has not, however, finished its work. The USB camera has been watching the stance of our female shopper, and logs this information as 'viewership data' which might include the length of time that the display was being actively viewed by our shopper, and what she was watching when she touched the display's controls. The viewership records are integrated into an enterprise-level analytics system. When the shopper later makes a purchase of a fashion item and redeems the coupon, this will be reconciled with the viewership data and analyzed. The store's product marketers can use this data when they ask questions such as:

- What triggered the decision to press 'Mobile Coupon?' Was it the ad, features of the merchandise, or the gift offer?
- When viewed by adult female shoppers, what promotions are most profitable?
- On average, how long does it take a viewer who goes on to buy a product to decide to claim a coupon or call up the store map and leave the display?
- How long, in seconds, should the promotional program run for before returning to the main menu (to stop the display from being hogged by window shoppers who have little intention of making a purchase)?

View demo video on YouTube

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Targeted, Flexible Messaging

The power of this technology comes from two important attributes:

- The advertising messages can quickly attain very precise relevance to the viewer through a combination of visual recognition and intelligent response to the viewer's input.
- Precise data about the nature of the viewer, the effect of the advertising on the viewer and the commercial outcome of the viewing are available to advertisers, enabling fast and effective refinement of advertising delivery.

This technology can be implemented today – it has been demonstrated publicly by Intel® in a proof-of-concept that has drawn large crowds at exhibitions around the world. (View video) But the principles that underlie the demonstration can be applied in countless different ways. Other implementations of digital signage incorporating local, distributed intelligence include:

- Dual advertising display panels on top of taxis in Seoul, South Korea. The embedded computer in the display incorporates a Global Positioning System (GPS) chip, making it location- and context-aware.
- Movie rental kiosks on the streets of US cities that rent DVDs are examples of transaction-enabled digital signage. Incorporating high-definition video screens, these kiosks can display movie trailers and information for users, and accept user inputs requesting information or buying DVDs. Video scanning capability will allow kiosks to tailor the movie trailers it displays to the demographics of the viewer.

The difference from conventional out-of-home billboard or in-store advertising is stark: this new state of the art in digital signage knows where it is and who is watching it, and can respond immediately and appropriately to the preferences and interests of the viewer. It is as far from being a dumb terminal – the function of a traditional ink-and-paper billboard – as it is possible to imagine. It is easy to see what is driving the aggressive market growth forecasts quoted earlier in this eBook.

But what is the technology that today makes this sophisticated equipment possible?

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Technology Architecture

Common to almost every device in the new wave of digital signage are a number of core capabilities:

- Ability to run a variety of complex software applications, such as payment processing, security, video recognition and user interfacing. These applications must run in parallel, and in secure workspaces so that a fault in one does not expose sensitive data in another.
- High-speed connectivity using common protocols such as Gigabit Ethernet, Wi-Fi, GSM/3G and PCI Express
- Sophisticated user interface, via keypad or touch control
- High-resolution graphics processing, capable of driving custom panel sizes in any orientation. Typically this is restricted to portrait and landscape modes, but some eye catching signs are tiled to fit particular spaces or walls.
- Dual/multi-screen graphics capability
- Large local data storage to hold bulky video files and program files and data

Image source: Intel

A noteworthy feature of this list it that it could be used, with little alteration, to describe the main features of the personal computer. It is not surprising, then, that the most successfully deployed architecture for digital signage is the embedded PC motherboard based on the Intel® x86 chipset family found in the majority of the world's PCs, but with certain modifications and extensions to adapt it for use not in a work station but in out-of-home displays.

Recent Intel enhancements to its x86 line-up, in the form of the 2nd generation Intel® Core™ i7 processor family, provide the raw hardware capability required for the new generation of digital signage terminals. The 2nd generation Intel Core i7 processor is a multi-core device containing processing cores and a high-speed graphics engine that can drive dual high-definition displays, even when these use custom panel sizes.

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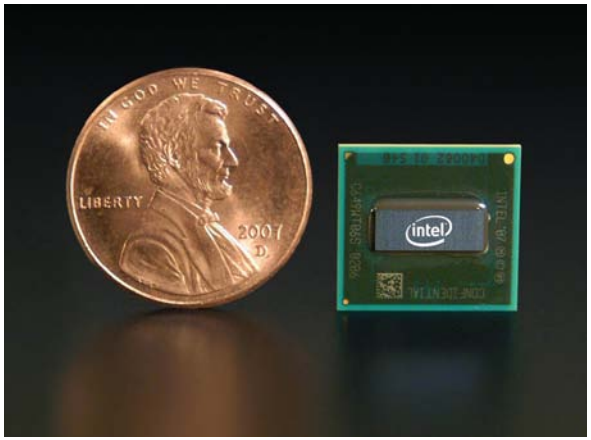
Beyond Performance

But it is not just processor performance that makes devices such as the 2nd generation Intel® Core™ processor family and the low-power Intel® Atom™ processor family so suitable for the suite of functions implemented in digital signage. Intel's pre-eminent position in the PC world means that OEMs working with Intel-based platforms benefit from:

- Access to a huge pool of experienced developers. x86 devices and the Microsoft® Windows® operating systems that they host are the most common targets for application development projects. OEMs that base their device on x86 find it easier to recruit developers to write digital signage applications.
- Wide availability of embedded operating systems and off-the-shelf application software. The most widely used operating systems in the embedded world, such as Microsoft Windows Embedded, Linux and VxWorks, are optimized for operation on x86 platforms. There is a wider range of commercial off-the-shelf software – firmware, drivers, protocol stacks, databases, user interfaces, browsers and so on – for Windows and x86 than for any other platform.
- Supplier commitment to a development roadmap.
  For more than 20 years, Intel has been delivering year-on-year improvements in the processing speed, graphics rendition and power efficiency of x86 devices. Intel is committed to continuing this process, giving OEM developers comfort that their own product roadmaps can benefit from Intel's enhancements while retaining the value of existing software development efforts.

From the OEM's point of view, Intel® x86 chips provide a ubiquitous platform that is extremely flexible, and supports fast and predictable application development processes.



Intel® Atom™ Processor

Image source: Intel

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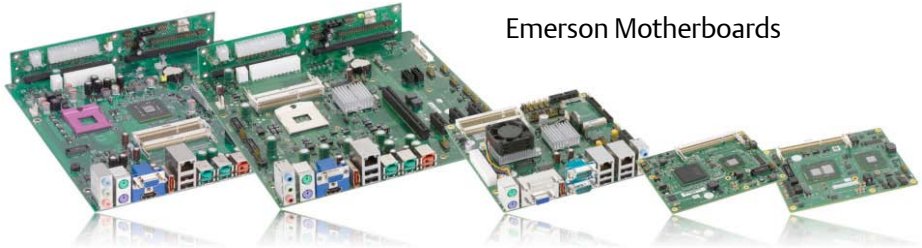
Intel: Optimized Chipsets for a non-PC Environment

The benefits of putting Intel® x86 architecture at the heart of product development strategy derive in large part from the x86 processor's position at the heart of the PC ecosystem. But the fact is that, while digital signage equipment is functionally very similar to a PC, it is not identical, and important aspects of its operation and management are different from those of a PC in a home or office.

This is why Intel manufactures a separate portfolio of embedded processors and support devices, which offer similar levels of speed and performance to standard PC processors, but which have additional features and attributes. Emerson Network Power bases its embedded motherboards on these Intel embedded platforms.

Some of these special embedded features are of particular importance to manufacturers of digital signage equipment:

- Remote management
- Low power consumption
- Security
- Integrated graphics capability
- Broad operating system support
- Extended lifecycle support
- Connectivity



Emerson Motherboards

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Remote Management

In its 2nd generation Core™ i7 and Core™ i5 processors, Intel® has implemented a feature called Active Management Technology (AMT) which allows for the remote control and operation of devices out-of-band even when the application or operating system has crashed.

It is implemented via a special AMT BIOS and a discrete set of components, including an Ethernet interface, on the QM67 chipset. This means that the device can be accessed and controlled independently of its main operating system (such as Windows Embedded or Linux), even from a power-down state. In effect, the AMT control function is carried on a virtual parallel network while using the same physical network connection.

This brings several benefits to digital signage operators, which in some cases own a widely dispersed range of media assets. For instance, it allows devices to be remotely rebooted, even when their operating system has crashed. Other remote maintenance functions possible with AMT include reloading known-good software, changing BIOS configuration settings, loading new drivers and loading a new operating system – all with the main system in power-down mode if necessary. This remote management capability can deliver large savings in maintenance and repair costs, as it eliminates many instances in which a technician has to be dispatched to a distant asset.

For in-store applications, the ability in AMT to remotely turn off and turn on digital signs offers huge power savings. It is common practice in stores to leave stand-alone displays running 24 hours a day, even though the store might be closed at night. This is because displays can be difficult to reach, or because staff might forget to switch them off or (even worse) be unable to successfully switch them on again when the store re-opens. The AMT function enables a remote controller to switch displays off and on at programmed times, thus avoiding energy wastage during the night and guaranteeing that the displays will be running before opening time.

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Low Power Consumption (Page 1)

Electricity costs are far from negligible for digital signage operators, so power savings and improved energy efficiency noticeably affect their bottom line. The low-power operation of the Intel processors in Emerson Network Power embedded equipment makes them ideal for use in energy-conscious appliances.

Proposed POP Display

Image source: Intel

As explained above, Intel's remote power-down capability almost eliminates power consumption when signs are not in use. But Intel has also implemented technology that saves power when a device is switched on. Intel embedded processors significantly reduce power consumption when the processor is idle by automatically switching to low-power states and turning off devices when not in use.

The Intel® Atom™ processor has been designed for low power from the ground up, while still offering excellent compute performance and dual-display driving capability. Typical board power consumption for Intel® Atom™ based designs range from 7-20W, while 2nd generation Intel® Core™ i7 mobile based boards typically range from 20-50W.

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Low Power Consumption (Page 2)

Security

Intel® embedded processors are capable of implementing the company's TXT (Trusted Execution Technology) feature. This is widely used in payment-processing applications, because it provides an isolated execution space in which sensitive data, such as credit card numbers, can be handled.

This means that such data cannot 'leak' into other applications, where they might be corrupted or inappropriately exposed. This is a crucial feature in digital signage linked to PoS terminals, for instance: customers would not want to see their credit card data or PIN number displayed on a monitor that is supposed to be running advertising promotions. TXT ensures that financial and other sensitive data are only exposed to those applications that are authorized to access them.

Image source: Intel

Integrated Graphics Capability

Embedded developers requiring high-definition video capability have been accustomed to using two separate cards – a processor card and a graphics card. The 2nd generation Intel® Core™ i7, however, has a high-definition graphics engine core integrated in the same die as the processor cores. Integrating the graphics processor enables the use of a single processor card, thus saving cost, space and power, and improving reliability by reducing component count.

As the examples cited above show (such as the Intel retail demonstrator and the taxi signage system in Korea), the ability to drive two displays simultaneously is often an important feature of digital signage (but rarely of PCs). Intel's processors – both the Core i7 and Core i5 parts and members of the Atom family – can do it.

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Low Power Consumption (Page 3)

Broad Operating System Support

Embedded applications such as digital signage equipment often use Microsoft Windows as the user interface. Intel embedded processors support common flavors of Windows, including Windows Embedded Standard 7, and in addition they also support other real-time operating system options such as Linux, VxWorks and QNX. Running multiple operating systems on a single platform by using Intel® Virtualization Technology (VT-x) is more common in systems that have a combination of user-facing functions and deeply embedded, mission-critical functions such as payment processing.

Extended Lifecycle Support

The market forces in digital signage equipment are different from those in the PC world. A commercial PC has a short shelf life, and is required to sell in very high volumes in order to earn a return, before becoming obsolete and replaced by a new model with improved features or functions.

Digital signage is not subject to consumer pressure for constantly improved features and performance. Volumes are smaller, and customer demand drives the creation of multiple variants of a platform product in order to meet the special needs of widely varying applications. In order to make the economics of digital sign manufacturing work, OEMs must develop long-lived platforms that they can tailor to each customer's needs. The short cycle of processor introduction, withdrawal and obsolescence that is acceptable to PC manufacturers is therefore not appropriate to the embedded world. Intel meets the requirement for long, predictable processor lifecycles by denominating special 'Embedded' processor and platform devices with a guaranteed minimum lifespan of seven years.

Connectivity

The 2nd generation Intel® Core™ i7 and Core™ i5 embedded processors come with a wide range of integrated connectivity options including the ubiquitous Ethernet protocol, through which most Internet-enabled devices go online. They also support PCI Express, which allows the simple interfacing of plug-in modules for WiFi or WiMAX wireless connectivity.

The devices also support multiple high-speed USB interfaces. This is important in digital signage, intelligent kiosks and PoS terminals, in which USB-enabled devices such as scanners, cameras, printers and weighing machines are widely used.

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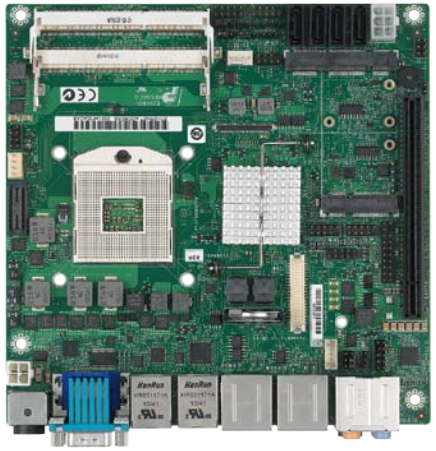
How to Evaluate x86 Motherboards for Digital Signage Equipment (Page 1)

In the previous section, this eBook explained why the economics of digital sign manufacturing demand the production of multiple product variants based on a single, long-lived platform. It also described important features – specialized remote management, secure execution of sensitive applications, dual-display driving and so on – that are required in digital signage but not in standard PCs.



Emerson MITX-CORE-800 Mini-ITX Motherboard

These same factors should drive manufacturers' decision-making when evaluating motherboard suppliers. The standard PC motherboard market is well served by manufacturers, most based in Asia, which produce rapidly evolving motherboards at low cost. These motherboards have very short lifetimes, and can go through the development-introduction-withdrawal-obsolescence cycle in as little as a year.

This product marketing model is wholly inappropriate for manufacturers of digital signage. The best value from a project to develop a digital signage product will generally be realized if this product is treated as a platform from which to develop multiple variants for different applications or customers.

This demands the use of a motherboard with a long guaranteed lifecycle.

If the OEM chooses an embedded motherboard from a member of the Intel® Embedded Alliance, such as Emerson Network Power, it can benefit from the use of an Intel embedded processor, with a guaranteed lifespan; in the case of Emerson Network Power, the motherboard itself will also enjoy a typical seven-year lifespan, thus giving the OEM confidence that its platform product will have a long period over which to amortise its development costs.

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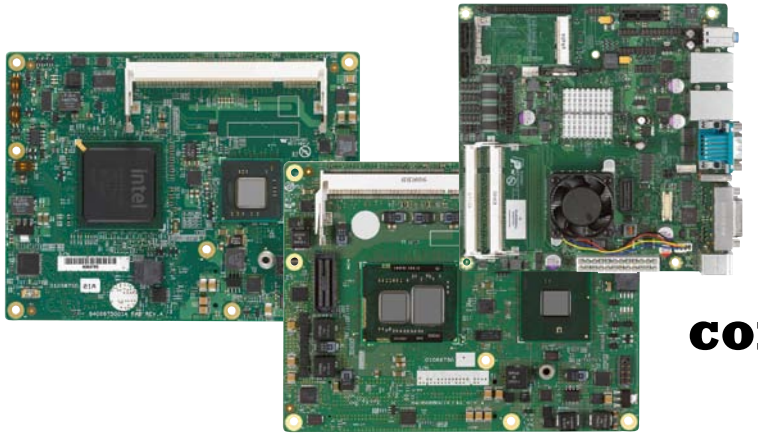
How to Evaluate x86 Motherboards for Digital Signage Equipment (Page 2)

Emerson Network Power's commitment to Intel's embedded roadmap and its Premier status within the Intel Embedded Alliance helps to extend this lifespan promise, since it enables the company to develop embedded motherboards in parallel with Intel's own processor development cycle. This often means that an Emerson Network Power motherboard supporting a new Intel embedded processor is introduced on the same day as the processor itself. This in turn gives motherboard users the opportunity to benefit from the full minimum seven-year processor lifespan.

In Emerson Network Power, OEM customers have a large, proven and experienced supply partner. Emerson is a global business with $21billion in annual revenues (2010). Manufacturing is Emerson's core competence, and every embedded motherboard is produced in Emerson-owned factories to high Emerson standards of quality and consistency.



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Exploiting a Fast-growing Opportunity

The number of opportunities for installing digital signage is hard to calculate – how many people would have thought of putting a location- and context-aware advertising display on top of a taxi? All that is certain is that marketers and advertisers are wildly enthusiastic about the promise of a technology that delivers relevant, engaging content in a format that allows precise measurement and tracking.

For OEMs and original design manufacturers (ODMs) considering entering or expanding in the market for digital signage equipment, the challenge is in developing mechanical designs and software applications that are tailored to the needs of each individual application. But the challenge is not in hardware development: the basic hardware and operating system exists today, in the form of Intel processors, which are familiar in PCs, optimized for embedded applications and hosted on embedded motherboards supplied by a secure, robust manufacturing organization such as Emerson Network Power.

For OEMs, grasping the opportunity in digital signage therefore depends on using resources that already exist and that cannot be bettered – the processor and embedded motherboard – and adding their own value in building an end product that is mechanically fit for purpose and provides the applications that each customer requires.

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Additional Resources

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The Embedded Computing business of Emerson Network Power enables original equipment manufacturers and systems integrators to develop better products quickly, cost effectively and with less risk. Emerson is a recognized leading provider of embedded computing solutions ranging from application-ready platforms, embedded computers, enclosures, motherboards, blades and modules to enabling software and professional services.

Manufacturers of equipment for telecommunications, defense, aerospace, medical and industrial automation markets can trust Emerson's proven track record of business stability and technology innovation.

Emerson's engineering and technical support is backed by world-class manufacturing that can significantly reduce time-to-market and help OEMs gain a clear competitive edge. And, as part of Emerson, the Embedded Computing business has strong financial credentials.

Let Emerson help your business improve time-to-market and shift development efforts to the deployment of new, value-add features and services that build market share. With Emerson behind you, anything is possible.

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