Everywhere you turn these days, digital signage is telling you where to go, what to buy, when the next train is, or even what to eat. Flat panel screens are as ubiquitous in public places as copy machines in business offices. Intel has forecast a staggering total of 22 million digital signs worldwide by 2015, with retail, corporate and transportation placements leading the way.

Yet one aspect of digital signage has remained relatively stagnant: content delivery. Cabling has certainly evolved to support the effort. Coax and VGA cables were replaced with HDMI cables, leading to HDMI-over-UTP cables, now evolving into HDBaseT technology. For every linear foot of HDMI or Cat 5 cable that content has to travel, however, there is the added cost of labor to pull a cable for each source. In addition, if a source or display is added, changed or moved, chances are that a new cable has to be run at a cost of thousands of dollars. And sometimes cabling is not even an option.

The logical answer is to cut the cord and go wireless, but most wireless systems to date have had distance, bandwidth and placement limitations making them viable solutions only for smaller applications. Digital signage integrators are often forced to return to the starting line to “go with the devil you know.”

That changed in late 2012 with the development of a breakthrough technology providing a powerful and reliable wireless solution for digital signage with impressive distance, ample bandwidth and full scalability. The solution pairs over-the-air broadcasting in use since 1931 with new ‘white space channels’ freed up in the 2009 digital TV conversion, allowing local personal broadcasting.
This new “Pico Broadcaster” is game-changing technology that dramatically simplifies the process of deploying digital signage in a multi-screen environment. With a single Pico Broadcaster, HD content can be streamed up to 350 feet to an unlimited number of digital televisions equipped with an ATSC tuner and over-the-air antenna. Reliable, powerful and scalable wireless digital signage is finally here.

Wired For Trouble

How much cable is required to run digital content from a computer in a rack to a ceiling-mounted screen 20 feet away? In most cases 30-50 feet of cable must be run from the rack to the wall, up to the ceiling, across the room, down the extension column, and then connecting to the screen. If the cable is HDMI, there is a significant drop in quality over 30 feet so higher-quality materials and additional shielding are required of the cable. Anything over 45 feet starts to require a signal booster. If running HDMI-over-UTP, the cable length could be extended to over 300 feet, but taking into account all the walls and ceilings the cable has to be run across, the effective reach from computer to screen is likely only 150 to 200 feet. Any longer distance requires fiber optics where the costs begin to hit the roof.

In addition to the cable costs, the average labor rate is $80 to $140 per hour per integrator, depending on the location of the project and the level of knowledge required. A typical cable run to install the project cited above would take two integrators half a day – not including repainting walls and ceilings that might have been damaged in the process.

The wiring problem is compounded by the fact that in some cases – such as in listed buildings that do not allow damage to walls or ceilings – there is no way to run cable at all. Combine these factors with the usual constraints of wired connections – such as tethering equipment to fixed locations and the need for new wiring if a display must be moved or added – and most AV professionals will opt to link sources to displays wirelessly wherever possible.
Wireless Pain Points

Wireless media distribution is the holy grail for digital signage integrators for reasons ranging from speed and simplicity to the practical challenges of hardwiring. Until recently, however, the applications for wireless-enabled digital signage were relatively narrow because of the limitations of wireless technology.

There are several wireless streaming media distribution systems on the market that work well, but only when paired with the right applications. The most popular streaming systems use WiFi, which is a trademarked name coined by the WiFi Alliance for any product using WLAN (Wireless Local Area Network) based on the IEEE 802.11 standard. These streaming systems can be useful for small installations that require wireless streaming from one source to up to four displays within the wireless range, but they are not appropriate for larger multi-screen deployments. Two main sticking points stand in the way of using WiFi in larger venues.

- **Limited Transmission Distance**
  The FCC restricts the amount of power output for wireless devices for health, safety and potential interference reasons, so indoor signal reach generally maxes out between 100 to 130 feet line of sight – not much farther than the distance from home plate to first base on a professional baseball diamond. Some systems with external antennas can almost double that distance but cost much more, so the savings compared to wired connections become blurred. Also, since wireless transmission distance is greatly affected by obstacles such as walls, ceilings, metal equipment racks, and even people walking or standing between the Tx (transmitter) and Rx (receiver), real use distance in most applications may be no more than 50 to 60 feet.

- **Limited Multicasting**
  Multicasting means the ability to deliver the same content from one source to many displays. Multicasting with today’s WiFi systems is usually limited to one Tx to three or four Rxs because of the nature of wireless technology and the number of channels available to stream content across. In addition, due to the limited number of available channels, only two or three systems can run concurrently within the same space in a typical installation before there is too much interference for a clear signal, meaning only up to eight to twelve screens can be supported within the 100- to 130-foot maximum radius.

Therefore, although WiFi has its place in smaller projects, the technology is not currently robust enough for true multi-screen digital signage. Other wireless systems for multi-screen digital signage using WiFi or cellular phone technology have limitations as well. They are trickle-feed systems that download content to onboard cache memory within a media player, so they are not real-time. They also require an existing WiFi infrastructure or cellular phone network, along with media players with extensive computing and graphics processing power that are usually installed behind each display. These factors add up to an expensive deployment.
White Space Broadcasting: The New Wireless

The need to stretch wireless media delivery capabilities has led to a fresh alternative for digital signage applications where traditional wireless solutions are unable to meet the range, scale and/or flexibility requirements of the project.

Introduced in late 2012, the new approach utilizes a portable broadcast station called a Pico Broadcaster that allows any audio-video content to be broadcast over the air and picked up by an ordinary digital television (DTV) up to 350 feet away – greater than the length of an American football field – as if it were a local broadcast station but on a smaller scale (hence the name “pico”). The device broadcasts over the UHF 500-700 MHz frequencies to an open local ‘white space channel’ and displays content on the receiving DTV in HD broadcast-quality resolutions of up to 720p or 1080i.

In the U.S., white space channels are a legacy of the 2009 conversion from analog to digital television that freed up bandwidth formerly used by analog TV channels. Unlicensed use of unoccupied channels below 700 MHz was approved in the U.S. by the Federal Communications Commission (FCC) in 2008. The FCC also defined three different device types that may broadcast within this white space: portable 40mW or 100mW devices, or fixed position 4W devices. The Pico Broadcaster is approved by the FCC and classified as a 40mW portable device.

Devices in the 40mW category can broadcast onto any available channel from 21 to 51. While boosting power to 100mW can substantially extend the signal range, 100mW devices are restricted to using bands with open adjacent channels on both sides to avoid bleed-over. To use an open channel 22.1, for example, channels 21.1 and 23.1 would also have to be vacant. This would limit or even eliminate channel availability in some markets. The 40mW option was chosen for the Pico Broadcaster to ensure that every geographic area in the country has at least one available white space channel, and in many cases 10 or more, for digital signage use.

Outside the U.S., other countries that have made the analog-to-digital-TV transition will offer the same white space broadcasting opportunities as soon as appropriate legislation is passed. Canada and the United Kingdom are among the countries expected to receive approval for unlicensed white space use in the near term.
A New Standard in Scale

The upshot is the birth of a completely new concept – wireless personal broadcasting technology – that conquers the limitations of WiFi-based wireless content distribution. With a single laptopsized broadcast station streaming content to appropriately equipped DTVs, digital signage integrators can now connect more screens at longer transmission distances without cabling than ever before. The technology offers four key benefits for larger installations.

- **A Signal Range up to 350 Feet**
  Broadcasting over the UHF spectrum with a 40mW device nearly triples the typical signal range available with WiFi solutions. Content can now be beamed omnidirectionally to DTVs as much as 350 feet (106m) away from the transmitter in all directions, enabling a distance of up to 700 feet (213m) between the farthest DTVs in an installation. This allows larger facilities to be serviced wirelessly with a single transmitter. It also allows content to be broadcast to both outdoor and indoor screens without cabling.

- **Improved Through-The-Wall Transmission**
  Using the 500-700 MHz UHF frequency rather than the 5 GHz RF spectrum used by WiFi systems makes it possible to more easily penetrate structural barriers. In general, the higher the frequency, the more signal loss it experiences. The formula for Free-Space Path Loss (FSPL) states that the loss is inversely proportional to the frequency and distance. Based on this mathematical formula, the loss between the 5 GHz frequency used by WiFi systems compared to the 500 MHz frequency used by the Pico Broadcaster – a 10 times greater factor – results in 100 times greater loss of data throughout the same wireless distance.

- **Unlimited Multicasting**
  Whereas a WiFi system requires a handshake between the Tx and Rx, which creates a limit on how many Rxs can be paired with the Tx, a TV tuner’s function is only to receive the broadcast signal. Therefore, there is no limit on the number of tuners that can be used with a single transmitter within the broadcast area. Since 2007 the FCC has required all DTVs in the U.S. to have an ATSC tuner. Consequently, use of DTVs offers a ‘free’ receiver (internal tuner) that eliminates the need for a separate receiver to process the signal. Content can be delivered to any number of DTVs within the broadcast range for a truly unlimited multicast capability.

- **Automatic Connectivity**
  Since the Pico Broadcaster requires no point-to-point link between a Tx and an Rx, there is no need to set up the Rx (built-in tuner) when a DTV is installed or moved to establish a wireless connection. Even when moving or adding a new DTV, content can be instantaneously received simply by tuning to the designated channel, eliminating the need for IT or AV technicians to set up connections after every change in screen configuration.
Technical Requirements

The Pico Broadcaster unit that is the cornerstone of this over-the-air wireless broadcasting system serves two primary purposes. First, it houses the onboard broadcast antenna that delivers the HD content. Second, it provides the Ethernet port used for transport stream input, network connectivity, and the internet connection required to obtain the FCC license enabling local white space broadcasting. Installations also require:

- **A computer or media player with IP-transport capabilities** that streams content to the Pico Broadcaster over an Ethernet connection. Most media players on the market will not output content via an Ethernet port, so a laptop or PC is the most straightforward way to deliver content.

- **Streaming software** that transcodes media files into MPEG-2 TS format, a requirement of ATSC tuners to be able to receive and demodulate into audio-visual signals. Shareware such as VLC or Live555 can perform this function, but the user must understand how to operate the software coding to properly execute the functions. To simplify the process, the Pico Broadcaster offered by Peerless-AV is equipped with custom software with an intuitive interface and drag-and-drop functionality to enable playlist creation and management. This software allows transcoding of files such as MOV, VOB, AVI, WMV and more to the MPEG-2 TS broadcast format.

- **Two static IP addresses** for controlling and streaming the content over the local network, respectively, and an active internet connection to maintain contact with the FCC database for licensing. It’s recommended that the static IP addresses be secured with the facility’s IT department for placing the Pico Broadcaster onto the network. Use of a router is also an option in scenarios where there are no legal or operational ramifications.
**Digital TVs with ATSC tuners** to process the over-the-air HDTV broadcast signal. All flat panel screens labeled as a ‘television’ that are sold today in the U.S. must be digital and have a built-in ATSC tuner, so this satisfies the tuner requirement. Some digital signage monitors do not have tuners, so a monitor can be used only if it can accept an ATSC tuner card or is used in conjunction with a stand-alone tuner box or media player that runs the content to the TV.

**Over-the-air antennas** to receive the broadcast. The antenna can be anything from a ‘rabbit-ear’ device to a high-gain powered antenna. Regardless of type, however, the best option is an omni-directional antenna with a low profile that can be positioned for clear reception of the broadcast signal without looking obtrusive. For installations that already are part of a coax network, a single antenna can be used at the head end of the network to receive the signal, as long as proper distribution amplifiers are used to send sufficient signal to the TVs.

**An available white space channel** to receive the content. In every geographical location throughout the U.S., there should be one to 10 or more unused white space channels that can receive content from the Pico Broadcaster. Find what’s available for the installation area by consulting a TV White Spaces database such as Spectrum Bridge’s ShowMyWhiteSpace.com or Google’s www.google.org/spectrum/whitespace. Enter the class of the product as a Portable 40mW device, then enter the address of the installation site, and the website will provide a list of available channels.

### Content and Channel Management

From a content management perspective, the fact that the Pico Broadcaster system is IP-based and lives on the network enables easy remote access to the computer delivering the content. This allows adding or changing the content via another computer on the network or even remotely tunneling in via a smartphone, with the appropriate software, to access the content.

From a channel management perspective, a single white space channel can currently receive a single stream of content. Multiple streams of content require multiple Pico Broadcasters to transmit from, and multiple available white space channels to receive the streams.

However, with software and hardware packages to be released in mid-2013, multiple content streams will be able to reside on a single white space channel by transmitting to sub-channels within the channel (for example 21.1, 21.2, 21.3, etc.). With this multiplexing option, multiple streams of content will be able to be delivered without ‘using up’ limited white space channels.

For multiplexing, it should be noted that ATSC tuners are limited to a bit rate of 19.4 Mbps (megabits per second) for an MPEG-2 video stream. A typical HD (High Definition) signal takes up around 10 to 18 Mbps, while an SD (standard definition) signal is 3 to 8 Mbps. Multiplexing therefore will require a strategy such as transmitting one HD stream (to channel 21.1) and one or two SD streams (channels 21.2 and 21.3), limiting each stream to the speed minimally required for the content, to deliver multiple streams through a single digital channel.
Installation Tips

Proper installation of the Pico Broadcaster system is key to receiving an optimized signal. As in a home where the antenna must be positioned correctly to receive channels clearly, the broadcast system must be installed properly to get the signal from the broadcaster to reach the intended DTV. Among the best practices:

- **The broadcast antenna should be installed as high off the ground as possible** – such as onto the rafters in the middle of the coverage area – to allow the signal to ‘rain down’ as directly to the DTVs’ antennas as possible. The Pico Broadcaster can be installed onto the rafters directly, or on ground level with the antenna remotely connected to the rafters via a coax cable to tether the broadcast antenna to the base unit. Remote connection of the antenna will reduce its broadcast signal, but keeping the equipment on the ground level allows for easier service if needed.

- **Radio Frequency (RF) signals as used by wireless systems** can travel through solid materials such as wood stud walls, but the more solid the medium, like reinforced concrete floors, the more the signal will be attenuated. This is especially true with metallic objects, as metallic surfaces reflect the RF signal, so keep metal away from line of sight between antennas.

- **In tighter spaces, it may be necessary to lower the broadcast power of the Pico Broadcaster** to avoid a phenomenon known as multipath. This is where the powerful broadcast signal reaches the TV antenna while also reflecting off the wall and hitting the antenna at the same time, causing multiple signals to be received by the antenna. When this happens, the signals cancel each other out since they are all on the same frequency, causing loss of signal. This phenomenon may also occur if two Pico Broadcasters are operating within the same space. Simply selecting a different channel solves the problem.

- **The DTV antenna should be omni-directional** so that the TV’s position relative to the broadcast signal will not matter. If possible, **leave the TV antenna in plain sight, or else use low-profile antennas that blend in well with the TV.** In some cases, it might be cleaner to run a coax cable from the TV to a higher area to connect the TV antenna to, or connect multiple TVs using a coax network and deliver content from a single antenna at the head end with an appropriate signal amplifier.

The Pico Broadcaster can also be installed directly to a coax network to feed HD content over coax cable. With the ability to control its output power, the Pico Broadcaster is also a good HD modulator with built-in distribution amplifier.
When used with these precautions, the Pico Broadcaster is the most powerful wireless digital signage tool available to integrators today. The ATSC tuners and over-the-air antennas eliminate the need for special receivers and associated power sources required by other wireless systems, simplifying setup and connectivity while also making it the greenest product of its kind. The fact that a single Pico Broadcaster covers any number of screens in a 350-foot radius also reduces content delivery costs and complexities of scale.

Redefining Wireless Digital Signage

In sum, white space broadcasting using the Pico Broadcaster multiplies the opportunities for delivering digital signage content wirelessly. Whether it’s a store broadcasting promotions and product demonstrations, a school transmitting educational content and school news, a football stadium streaming advertising to skyboxes, or any number of other venues and uses, the longer range and multicasting capabilities of over-the-air digital signage broadcasting enabled by the Pico Broadcaster make it possible for far more facilities to cut the content delivery cord and save thousands of dollars per installation.

Cables will always play a role in digital signage, and WiFi may play a role in wireless-enabling smaller deployments, but white space broadcasting seems destined to become the go-to technology for larger installations. It’s a ripple effect from the transition to digital television that freed TV spectrum for unlicensed use that can eliminate miles of cabling, open the door for digital signage use where pulling cables is not an option, and remove cables and labor from the cost equation. For the digital signage movement, it may be just as significant as the advent of digital television itself.

About Peerless-AV

Peerless-AV, a Peerless Industries, Inc. company, is a leading designer, manufacturer and distributor of Made-in-the-USA audiovisual mounting, accessory and digital content delivery solutions as well as the industry’s first fully sealed outdoor TVs for commercial and residential applications. The company’s innovative AV products span off-the-shelf, commercial and custom flat panel, projector and tablet mounts as well as cables, AV carts and stands, medical carts and stands, AV racks, AV furniture and a wide range of other accessories. The Peerless Technology Division specializes in wireless, kiosk, touch, digital audio and connectivity technologies that simplify today’s complex digital equipment installations. Peerless-AV manufactures over 3,600 products that serve original equipment manufacturers, commercial integrators and consumer retailers in 22 vertical markets through direct sales representatives and authorized distribution. For more information, visit www.peerless-av.com.

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