

# Displaying Data in Thin Air

**T**wo new techniques represent the latest approach to display technology: doing away with the screen. While unlikely to replace the desktop computer monitor, these thin-air displays could eventually be put to use in product showrooms, museums, military training facilities, corporate conference rooms, trade fairs, theme parks, and advertisements.

Chad Dyner, a graduate student at the Massachusetts Institute of Technology and chief executive officer for IO2 Technologies, has invented the Heliodisplay, which condenses the air above a video projector. The device then projects an image onto the condensed air, Dyner said.

IO2 has constructed proof-of-concept devices with 5-, 15-, 27-, and 42-inch screens. These can display two-dimensional images that hover above the projector. Because they are displayed on a surface that is not flat, the images appear 3D from a few feet away and can be seen from any surrounding position.

Dyner said he created IO2 Technology to license the technology to “one or more key players in the display market or companies that have the manufacturing capability to produce and distribute Heliodisplay.”

Senior researcher Ismo Rakkolainen and Professor Karri Palovuori of Finland’s Tampere University of Technology have developed the FogScreen, a display surface made out of a cloud of water vapor diffused into the air as a very dry fog. A projector can display images on the FogScreen.

“It appears dry to the touch, so it feels just like air,” Rakkolainen explained. Viewers will thus see images they can walk through without getting wet. The water vapor is diffused between thick layers of emitted stable air, which keeps the fog thin and flat, enabling high-quality images, he added.



**FogScreen technology, invented by two Finnish researchers, projects an image onto a display surface of water vapor diffused into the air as a very dry fog. Viewers can even put their hands through the images.**

The first permanent prototype was installed in the Vapriikki museum in Tampere and has since been loaned for use in France. FogScreen is renting some devices and expects to begin sales soon.

Rakkolainen said, “This project started as a wild idea.” The researchers formed FogScreen Inc. last year and are currently marketing the device.

Although Heliodisplay and FogScreen are interesting, it remains to be seen if

they will be cost effective and will find an important use, said analyst Chris Chinnock of Insight Media, a display-industry research firm.

“Both are more likely to work as advertising or information screens in museums, public displays, entertainment centers, etc.,” he explained. “These are specialty displays that need a novel experience and they need to be marketed and positioned as such.” ■

—Linda Dailey Paulson

## New Wireless Technology Provides Quality of Service

**A** new technology promises to guarantee service levels to wirelessly streamed digital content and thus may provide the basis for new digital entertainment products such as camcorders and other video and audio players.

The IEEE is working on standard 802.15.3a, which amends the organi-

zation’s 802.15.3 ultrawideband (UWB) standard for high-rate, short-range wireless networks.

The amendment prevents the interruption of a data stream after a client device and the wireless network establish a link, explained Robert Heile, chairman of the IEEE’s 802.15 Working Group and chief technology

officer of Appairt Technologies, a wireless-multimedia-product vendor.

IEEE 802.15.3a prevents interruptions by assigning a stream to a specific time slot that cannot be used by another stream until the first data set is fully transmitted. Networks using IEEE 802.15.3a also ensure continuous streaming by detecting noise from a source, such as a cordless telephone, affecting one transmission channel and assigning multimedia traffic to another channel not experiencing interference, thereby avoiding interruptions.

IEEE 802.15.3a also helps quickly detect lost packets via cyclic-redundancy-check techniques. "It is designed to get packets retransmitted fast enough so that you don't know you lost them," Heile explained.

The technology transmits data for up to 100 yards at 55 Mbits per second, quickly enough to efficiently handle multimedia traffic, he added.

Consumer-electronics and PC companies have been developing products using Wi-Fi wireless-LAN technology (IEEE 802.11) to handle multimedia streaming. However, Wi-Fi was designed to deal with bursty, rather than streaming, traffic. The technology also doesn't assign data to exclusive time slots.

In addition, Heile said, IEEE 802.11 uses only 30 to 40 percent of its available bandwidth, while IEEE 802.15.3a uses 80 percent.

Ian McPherson, an analyst with the Wireless Data Research Group, a market-analysis firm, said IEEE 802.15.3a will be important because "there will be a need for quality of service as digital content matures."

A catch with IEEE 802.15.3a is that it is a form of UWB. UWB sends the various pulses of a single transmission over a relatively large part of the radio spectrum, not just at a specific fre-

quency or narrow frequency range as is the case with cellular-phone and other radio-based technologies.

Unlike the US, many countries don't permit commercial UWB transmissions because their regulations address only technologies that operate at a fixed frequency or a narrow frequency range.

Heile said IEEE 802.15.3a's success depends largely on whether many countries permit UWB in the future. If so, IEEE 802.15.3's only possible competition could come from the European Telecommunications Standards Institute's HiperLAN 2, a wireless standard with quality-of-service modes, McPherson noted. However, he added, "It's complex and difficult."

Heile said the first IEEE 802.15.3a products available will probably be dongles that establish connections between consumer-electronics devices and PCs. ■

—Linda Dailey Paulson

### Computers That Don't Look Like Computers

They look like breadboxes, toy log cabins, old radios, gasoline cans, even dolls. But tucked inside the interiors of these items are the guts of a PC. It's part of a growing trend by enthusiasts of constructing computers in unlikely host objects.

For example, Henry Minsky, a software architect with Internet tool company Laszlo Systems, converted an old Teletype machine and an old wooden-case radio into PCs. Minsky said he wanted his computers to have an old-fashioned, retro look.



***This PC, built within the case of an old radio, is an example of a new trend in which enthusiasts build computers in unlikely host objects, including breadboxes, gasoline cans, and even dolls.***

Enthusiasts face numerous challenges in building these hidden computers. Frequently, space is limited within the host object, and the interiors were not designed to accommodate wiring, provide ventilation, and otherwise house PC components.

Minsky said he installed a large heat sink and a slow, quiet fan, as well as a DVD/CD drive in both of his PCs, which run Linux. He eliminated the need for external cables by using wireless Ethernet.

A key to the smaller versions of hidden computers are smaller motherboards, such as the mini-ITX, developed by Via Technologies and used in commercial machines by vendors such as Tranquil PC and Hush Technologies.

The 17-centimeter × 17-centimeter mini-ITX (about half the size of a typical motherboard) is available with 600 Mbytes to 1 Gbyte of memory and includes a CPU comparable to an Intel Pentium 3, which uses less power and produces less heat than today's powerful microprocessors, said Rick Clayton, Via's sales program manager.

Because they use slower CPUs, the hidden PCs generally aren't used for advanced computing. In addition, mini-ITX boards sacrifice flexibility. For example, users can't add more than one video or sound card, and the processor is soldered to the board. ■

—Linda Dailey Paulson

# Reversible Computing May Improve Mobile Performance

**R**esearchers are working toward developing one of the first reversible computers, a machine that promises to reduce energy consumption and thereby enable performance improvements in cellular phones, laptops, and other battery-operated devices.

Reversible computers, also called *adiabatic systems*, recycle their energy and thus emit very little heat. This lets computing power grow without hitting the technology wall created by high-performance chips releasing large amounts of heat.

Energy efficiency and heat reduction are important for mobile devices, which run on limited-life batteries and have few resources to provide cooling; for desktops, which are becoming more powerful but are also running hotter and hotter; and potentially for switches and routers, which are increasingly fast and functional and thus consume more energy and generate more heat.

Adiabatic systems conserve energy because they delete little or no data. Computing systems discharge energy and give off heat when storage nodes suddenly change their voltage from positive to negative, which occurs when a bit changes its value. Thus, deleting information uses energy, and the less information that systems erase, the less power they use.

Moreover, rather than use up new energy sources, reversible systems reuse the energy already in their circuits from holding on to the data they contain.

“A normal computer throws away all that energy,” explained Assistant Professor Michael Frank of the University of Florida’s College of Engineering, who has developed reversible circuit designs over the past few years and is currently creating a demonstration chipset.

Reversible systems work with algorithms that don’t require data to be erased. This includes algorithms that run ongoing processes—such as the addition of a long list of numbers—that build on one another and thus don’t need to eliminate early steps.

Frank received a \$40,000 grant from the Semiconductor Research Corporation, an industry semiconductor-research-management consortium, to conduct a feasibility study on a proof-of-concept reversible computer.

SRC is interested because reversible computing is one of many possible methods for reducing a system’s heat level while allowing chip performance to scale, said Ralph Cavin, the consortium’s vice president for research operations.

MIT’s Reversible Computing research group developed a proof-of-concept reconfigurable reversible chip called Flatop.

However, MIT senior research scientist Tom Knight said he is no longer working on the project. Knight explained that he found it impractical to maintain both high performance and

low levels of heat generation and energy usage with reversible computing.

Reversible computing would require new hardware designs, software, development tools, programming languages, and compilers.

Businesses traditionally have resisted such major system architectural changes but may not have much choice when it comes to reversible computing. Frank projects that by 2030, increased heat production will overwhelm conventional computer systems, although some improvements could extend traditional approaches by another five to 10 years.

He estimated that adiabatic technology may begin showing up in embedded systems possibly during the next few years, in portable devices by about 2007, and in desktops by about 2013. ■

—Linda Dailey Paulson

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