CHARGING AHEAD

Charging Ahead: Intelligent Wireless Power for Real World Environments

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The explosive growth of the portable electronics industry has helped to reinvent the way consumers and businesses work, play and communicate. Laptop computers, mobile phones, digital cameras, MP3 players and other devices are now fixtures of everyday life.

This growing demand for mobility and the desire to remain “connected” to data, messages and contacts has created the need to maintain battery power or else risk unwelcome downtime. Ensuring portable devices are adequately powered requires an array of cumbersome charger cables and wires. It also results in the inability to find sufficient numbers of electrical wall sockets, maxed-out power strips, and workstations and spaces that reveal a mess of tangled wires.

New battery charging solutions have emerged to minimize or eliminate cords and wires, while keeping portable electronics powered up and ready to go mobile. Current technology options are in various states of readiness, each with its own set of benefits and drawbacks.

This paper identifies some of the better-known developments, assesses their market readiness and compares their potential. Most notably, eCoupled™, a new wireless power delivery system developed by Fulton Innovation is examined for its impact on the built environment and, subsequently, its users. This paper also includes some market forecasts for wireless charging and discusses the push for standards in this new field.
INTRODUCTION TO WIRELESS CHARGING AND INDUSTRY FORECASTS

From the alarm clock and coffee maker, to desktop computers and flat screen TVs, individuals operate and rely on a growing number of electronics throughout any given day.

According to the Consumer Electronics Association, the average U.S. household owns 25 consumer electronics products.\(^1\) It’s also estimated that by 2013, the average U.S. household will have 2.5x as many digital media devices (computing, gaming, consumer electronics, portable and wireless devices) in use as in 2008.\(^2\)

IMS Research, in their February 2010 report, “The Growth Potential for Wireless power and Charging”\(^3\) projects that over 900 million devices will be in the market by 2019 using wireless charging and that over 50% of the market will use embedded solutions.

IHS iSuppli’s 2010 research forecasts 250 million wireless charging devices by 2014.\(^4\) The Pike Research report from November 2010 stated that “the wireless power market will reach an inflection point when it crosses the $1 billion revenue mark in 2012, and by 2020 wireless power system revenues will exceed $11.8 billion worldwide.”\(^5\)

Many electronics are plugged in and stationary, but many more are portable devices that have become indispensable tools for living, working and communicating. Among the most popular are mobile phones, laptop computers, MP3 players, and e-readers.

Accompanying the rise in electronics use is the need for added power connectivity, a particularly essential requirement for portable electronic devices which must be regularly tethered to power through battery chargers. Users are forced to rely on the existing numbers of wall sockets within current living and workspaces, which can be woefully inadequate given they are generally engaged for powering stationary electronics.

In fact, the vast majority of today’s offices, conference rooms, collaborative workspaces and student environments do not adequately support the substantial numbers of portable electronic devices in use and the need to keep those devices charged. Each day, portable device users enter workplaces, community spaces or campus buildings and juggle chargers, swap out electronics currently being served by the limited supply of outlets, or borrow extension cords. This is continuously repeated as users travel daily from their homes and cars, to desks and conference rooms, to airports and hotels.

Simply having multiple battery chargers at the ready isn’t a viable solution given that electrical outlets are in short supply. Likely as not, those many dedicated chargers may not be readily available when they’re needed, especially as users exercise their desire for mobility.

Today’s facility managers, architects, interior designers and specifiers are challenged to accommodate the increasing power needs that come with a world that runs on portable devices.

\[^1\] Consumer Electronics Association
\[^2\] Consumer Electronics Association
\[^3\] IMS Research
\[^4\] IHS iSuppli
\[^5\] IMS Research

“We hope to see 30 percent to 40 percent of cell phones using wireless charging technology within two years.”\(^6\)
THE WIRELESS FIELD OF SOLUTIONS

There has been a great deal of activity in wireless power solutions for obvious reasons. As mentioned, with the proliferation of portable electronic devices comes a proliferation of power adapters and chargers. The lack of standards in this area has created a headache for consumers and an opportunity to introduce innovation. Therefore, several companies are attempting to “cut the cord” with solutions that charge or power devices wirelessly. The possibility of wireless power transmission was first demonstrated in the 1890s by Nikola Tesla using the scientific principle of electromagnetic induction. It’s a discovery that’s very much used today.

Think of the electric toothbrush or electric shaver. There’s the base or charging station and there’s the actual cordless device. Induction charges the device by creating a magnetic field. The charging station holds one half of the transformer or primary coil used to conduct power, while the brush or shaving unit holds the other half, or secondary coil. When brought together, a varying magnetic field in one coil induces a current in the other coil, thereby allowing the battery to charge, without exposed contacts. It sends energy through inductive coupling to the electric toothbrush or shaver, which stores the energy in its batteries. These devices and chargers are proprietary and will only work with the specific device with which they were purchased. Technology has now advanced and will enable an open standard where one charging station can power multiple devices.

The most promising of portable charging solutions in the works and in the market rely on wireless technologies. They typically fall under the categories of magnetic induction, radio frequency/power harvesting, conduction and optical. The radio frequency and optical categories are limited to very low power and do not offer a current solution to charging consumer electronic devices. Conduction requires a contact surface interface and has associated limitations. The most promising and popular technology employed in wireless charging is magnetic induction. Magnetic induction can be further subgrouped into tightly coupled or highly resonant systems. Tightly coupled systems are limited in spatial freedom of gaps between the wireless charging surface and the electronic device of often less than 10mm., but offer the best efficiency and least emission concerns.

One of the biggest challenge for those companies pursuing wireless innovation is the standardization needed within the portable devices themselves. Portables must have a secondary coil that’s standard so that a wireless charging solution can accommodate any portable device. This would require all device manufacturers to build standardized technology into their devices—an event that may come sooner rather than later.

In December 2008, the Wireless Power Consortium was formed within the industry to pursue this very objective of creating a common global, low-power standard for wireless charging. This will ensure the interoperability of devices and primary charging systems so that devices will work anywhere in the world. The Wireless Power Consortium, which has grown to include over 80 international companies, released its low power standard in August 2010. This is known as the Qi standard. Products designed to this Qi standard are interoperable with common charging stations. This standard is being developed with major contributions from one notable wireless charging solution—eCoupled™ intelligent wireless power technology.
The Consumer Electronics Association is also actively contributing to this emerging technology by publishing nomenclature defining wireless charging and developing guidelines for emissions and efficiency.

TECHNOLOGY DESCRIPTION

Wireless power requires two coils—the power supply coil is built into a surface, and the receiving coil is built into a device to power or charge. A shared (coupled) electromagnetic field is generated when the power supply and receiving coils are positioned near each other wirelessly transferring power to or charging the device.

HOW ECOUPLED WIRELESS POWER WORKS

1. An eCoupled-enabled surface recognizes devices with embedded eCoupled technology
2. The surface and device communicate to determine power needs
3. Power is sent from the supply coil to the receiving coil in the device
4. The surface and device communicate to monitor and adapt the power to meet the needs of the device (intelligence)
5. Power is deactivated when the device is fully charged or has been removed from the surface

LOW POWER (cell phones, mp3 players, etc.)
Place your cell phone down and it automatically starts charging—no plugs, no cords. The power supply coil is built into the car’s center console.

MEDIUM POWER (laptops, power tools, etc.)
Set your laptop on your desk and it is wirelessly charged—no more lugging around power cords. The power supply coil is built into the desk.
A SIMPLE, SAFE, SMART SOLUTION

With eCoupled intelligent wireless power technology, ordinary work surfaces can be transformed into wireless charging stations, eliminating the need for power cords and battery chargers. Tables and desktops or drawers can be embedded with coils that initiate charging, thereby converting them into easy charging stations for laptops and cell phones. Using the wireless power of inductive coupling, the furniture’s charging surfaces transfer energy to any eCoupled-compatible device.

Fulton Innovation is the inventor of eCoupled technology and is leading the effort for global standardization. If successful, predictions are that "we may soon be rethinking how we organize the tech in our homes...no more designing around the power outlet."

Leggett & Platt has applied eCoupled technology to the primary charging side/surface of eCoupled inductive coupling. This self-contained module called Helios is being integrated into a number of KI furniture applications.

Leggett & Platt’s Helios Wireless Chargers integrate into furnishings and plug into conventional 110 volt AC power. eCoupled’s primary coil sends out a pinging signal seeking any Qi enabled device in need of power or charging. If a Qi enabled device, such as a laptop computer is placed on top of a Helios surface like a desktop or in a drawer, the eCoupled technology will recognize the device and tailor its power profile to deliver exactly what’s needed. This can be an AC voltage direct power, or a DC voltage for recharging batteries within a device.

Third-party companies have made retrofit adapters or cases that can enable existing cell phones and laptops with eCoupled capability. Numerous cell phone manufacturers have launched or will soon be launching Qi compatible phones with the secondary coil integrated into the hand set. Likewise, a variety of office, school and healthcare furniture solutions will also debut that integrate eCoupled™ technology, further advancing the wireless charging movement.

eCoupled technology is safe and efficient. Devices charge at a rate comparable to traditional charging (plugged) without exposed cords or contacts between the charging surface and the electronic device. The actual inductive coupling can be up to 98% efficient, similar to the efficiency of a conventional outlet. Having no cords or adaptors allows increased efficiencies on the jobsite, throughout the campus and on the move.

CONVENIENCE, PRODUCTIVITY, SAFETY: THE MANY BENEFITS OF ECOUPLED WIRELESS

Imagine working at a desk in a cordless environment. Your lamp, cell phone, laptop computer, digital camera and PDA are kept charged or directly powered without any cords. Mobility is easy. Walk to a conference room with your laptop and cell phone and simply set the devices on the eCoupled-enabled conference table to continue your wireless experience uninterrupted.
Such convenience is multiplied when there’s an entire eCoupled-enabled ecosystem in which to work and live. Imagine that automobile consoles, hotel furniture, kitchen counters, nightstands, coffee-shop tables, even seating throughout every workplace, campus and residence provide wireless power. No more consequences of forgetting to carry chargers; or worse, leaving a charger behind at an out-of-town hotel or across-town location and facing the associated expense and hassle of replacing or retrieving it.

In today’s world, staying connected has become synonymous with productivity. Bringing laptops and cell phones to meetings is more commonplace than ever. The proliferation of WebEx conferences, PowerPoint presentations and the need for continued access to the Internet, e-mails and data during team meetings and presentations generates increased demand for wireless power systems.

eCoupled meets this demand and helps further the drive for productivity. It’s interoperable with any Qi enabled cell phone and laptop. Therefore, charging surfaces throughout any environment can power up multiple devices regardless of model or voltage requirements. Additionally, the intelligent charging system senses what condition batteries are in and charges accordingly to protect and extend overall battery life.

The elimination of cord clutter is, in itself, a desirable safety feature. Additionally, eliminating the associated risks of improperly or partially plugged-in cords along with the heat generated from chargers and power strips makes offices, conference rooms and homes safer.

Safe for use, especially in environments with access to water (bathrooms, kitchens, break rooms, cafeterias, etc.), eCoupled has been tested for FCC, EMI and electrical compliance. The risk of electrical shock has been reduced as there are no electrical outlets and no metal connectors between the charging surface and the Qi enabled device. The technology also offers protection from electrical surges and powers down to save on electricity once an electronic device has been fully charged unlike many traditional chargers which continue to draw power even after a device is disconnected.

**SUMMARY**

A wireless world is already here. It’s only a matter of time before wireless charging enters the mainstream. When it comes to an intelligent wireless power technology, the most logical path to support the wireless world is eCoupled.

In the very near future, businesses, schools and municipalities will equip their spaces and environments with eCoupled and inductive charging that’s built right into furniture solutions. Before purchasing electronic devices, consumers will take into account whether or not those devices are eCoupled-enabled. Both sides are “leading the charge” for the simplicity and convenience that eCoupled wireless power provides.

FREQUENTLY ASKED QUESTIONS

Who developed eCoupled technology?
Fulton Innovation developed eCoupled technology and has worked with it for more than 10 years. Fulton is headquartered in Ada, MI, and develops new technologies for commercial and residential use. Through its partnership with Fulton Innovation, Leggett & Platt has developed Helios, the energy source inside eCoupled-enabled surfaces that charges devices. Leggett & Platt is leading the commercialization of eCoupled technology to power products in commercial vehicles, and residential and industrial furnishing applications. Leggett & Platt is also pioneering surface-side wireless power options for office, healthcare, and educational furnishings. Visit FultonInnovation.com for more information about eCoupled’s inventor.

Why is wireless power unique?
Wireless power uses inductive coupling to transfer energy from a charging surface to any eCoupled-enabled device. The Leggett & Platt Helios, the energy source inside eCoupled surfaces, adapts eCoupled technology’s operation to match the needs of the devices it powers. This two-way communication determines not only a device’s power needs, but also its battery life and charging lifecycles, keeping devices running at peak efficiency.

How much power can a wireless power source supply?
The Leggett & Platt Helios can power a range of devices from the milliwatts required by a cellular phone to the kilowatts required by laptop computers. The Leggett & Platt Helios’ medium-power application is capable of providing up to 100 watts of power.

Once a device is fully charged, will the technology continue to charge?
eCoupled technology is intelligent wireless power. Two-way communication between the charging surface (primary-side or surface-side) and the device (secondary-side) determines not only the device’s power needs, but also its battery life and charging lifecycles. The Leggett & Platt Helios intelligently responds to the power needs of the device and supplies electricity accordingly. When the device reaches a full charge, the Leggett & Platt Helios shuts off to prevent overcharging.

How long does it take to charge devices wirelessly?
Devices charge at a rate comparable to traditional power sources.

Will any electronic device work with eCoupled technology?
The Leggett & Platt Helios is designed to work with other eCoupled-enabled devices. For wireless charging to occur, the surface- or primary-side technology using a Leggett & Platt Helios must be paired with another eCoupled compatible device. Visit eCoupled.com for a list of eCoupled partners.

How does wireless power benefit consumers?
The practical benefits behind wireless power are obvious. Anyone who has been inconvenienced by wires, cords, and chargers can look forward to charging their devices wirelessly. Simply place the device on the charging surface and electronics recharge, wirelessly. Additionally, wireless power is designed to boost efficiency by reducing time lost to off-site and home charging.
How much will eCoupled-enabled products cost?
Pricing varies by product type and manufacturer, but in general the addition of Leggett & Platt’s Helios technology to a product’s existing design platform is competitive.

Can eCoupled technology transfer data?
Fulton’s eCoupled technology will wirelessly transfer data up to 1.1 Mbps.

Is eCoupled technology proven? How do we know it works?
Wireless power is a proven technology developed by Fulton Innovation. Fulton Innovation uses eCoupled technology in its eSpring water filtration system, which has been on the market for over ten years with more than 1.5 million devices sold in 40 countries.

REFERENCES

3. IMS Research, February 2009 Report
4. IHS iSuppli 2010 Research
5. Pike Research, November 2010
6. China Daily, November 2010