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## **MAKING WIRELESS TRULY WIRELESS: THE NEED FOR A UNIVERSAL WIRELESS POWER SOLUTION**

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## ABSTRACT

Wireless power is not a new technology. Different embodiments have been in development for over 180 years with differing degrees of success. However, until recently, with the invention of the microprocessor, wireless power has not been a viable solution for the challenges facing wired technologies due to inefficiencies and lack of control, causing safety and other issues. Several companies and institutions of higher learning have recently presented solutions to the challenges delaying the introduction of efficient wireless power for mass adoption, but this positive development has brought with it a new set of challenges including the problem of proprietary solutions versus the creation of an interoperable global standard. Consumer research suggests that a universal standard is the preferred solution, so it is now up to the companies interested in developing and manufacturing these solutions to develop a standard that will allow consumers around the world to power their devices across a broad range of brands and power needs under a single, interoperable standard. This solution will, like the Wi-Fi Alliance did for wireless networking, create a new protocol for how people interact with power.

## EXECUTIVE SUMMARY

Since it was first introduced as a concept and developed as a lab experiment over the last 180 years by notables including Hans Christian Ørsted, Michael Faraday, Nikola Tesla and Guglielmo Marconi, wireless power has been a technology steeped in possibilities and promises of increased levels of convenience and freedom for consumers around the world.

As wireless power has developed over the years, an increasing number of companies have been and continue to push toward proprietary solutions using several technologies, including inductive coupling, conductive coupling and radio frequency (RF). Unfortunately, the proprietary approach to bringing wireless power to market is creating a potential challenge that mirrors one of current wired power technologies' greatest issues: that of offering consumers a single, globally accepted solution for powering different devices with different power needs across a wide range of brands.

The solution is to follow the example of organizations like the Wi-Fi Alliance and publish a single global standard through a cooperative organization of international developers, manufacturers and distributors, which will serve as the blueprint for utilizing wireless power implementation worldwide. By approaching mass integration of wireless power through this method, many questions, including supply chain considerations, price point, device and infrastructure integration, efficiency, safety and range of power needs can all be addressed collectively, finally bringing wireless power out of the ether of science fiction and into the world of a viable real world solution, cutting the last cord.

## INTRODUCTION – THE STAGE IS SET

We live in a world that is rapidly progressing toward newer and greater levels of convenience, connectivity and freedom. This is the age of the wireless power and communications revolution, where everything from handheld consumer electronics to home appliances to transportation is incorporating wireless technologies to create new levels of

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convenience, interaction and monitoring. While tremendous progress has been made because of technologies including Bluetooth, Wi-Fi, radio frequency (RF), Ultra Wide Band (UWB) and global positioning systems (GPS), one last tether has kept consumers from making the leap to a completely wireless lifestyle – the power cord. In research conducted by the

<sup>1</sup>Alliance for Universal Power Supplies. "The Facts and Market Drivers." PowerPoint presentation for Organizational Meeting. June 13, 2008.

<sup>2</sup>Greenburg, Ken. "Awash in Incompatible Power Supplies, Consumers Say Enough is Enough, New Green Plug Survey Reports." Edge Communications. May 27, 2008. info@edgecommunicationsinc.com.

Alliance for Universal Power Supplies, consumer demand for “simplicity, a better charging experience and convenience,” along with manufacturing, usability, waste and environmental concerns surrounding the billions of power adapters that are produced and shipped each year globally, have created a surge of interest in wireless power solutions.

In association with Chicago market researcher Synovate, Green Plug ([www.greenplug.us](http://www.greenplug.us)), an organization committed to creating a single plug solution for electronics, asked 1,000 online consumers about their attitude toward purchasing consumer electronics devices, which typically come with external power supplies that don't work with any other product.

According to the survey, conducted in April, 2008, “31 percent of respondents said they regard incompatible power supplies as ‘wasteful’ and have many unused adaptors just lying around, while 30 percent described the situation as ‘frustrating’ – agreeing that forgetting to bring the right charger when leaving the house can prevent the use of an important device such as a laptop, cell phone, camera or music player. Another 18 percent said that they never thought about the situation before, 13 percent said it doesn't really bother them and 8 percent said it is ‘costly’ – and that they have had to purchase replacements when forgetting to bring the required charger to the office, school or on a trip.”

Consumer demand, coupled with the formation of several companies in the last decade that are offering viable wireless power solutions, has generated an accelerated race to market for wireless power solutions ranging from proprietary pad and adaptive solutions to integrated near-field and broadcast technologies pursuing international standards – all of them promising the right answer.

#### **THE CHALLENGE – THE EMERGENCE OF WIRELESS POWER AS AN INDUSTRY**

As consumer demand and multiple solutions ranging from inductive coupling to conductive coupling to radio frequency (RF) and other broadcast technologies converged on the emerging wireless power industry, questions at the consumer and developmental levels began to develop. Is wireless power safe? What is the additional cost? How will this technology come to market? Is it efficient? Is there a universal, interoperable solution? How much power is the technology able to handle? In addition to the developing questions, a challenge already facing wired technologies also began to emerge: the companies beginning to answer the questions and developing the solutions started on a fast track focused on developing proprietary applications and being first to market rather than on pursuing a global standard, which addresses these issues.

This approach has segmented the wireless power industry and, as a result, the media and private social media conversations are seeing sometimes conflicting answers from multiple points of view, depending on the embodiment being implemented, that are creating confusion about the technologies in the marketplace and potentially delaying the implementation of useful new wireless power embodiments.

#### **THE SOLUTION – COLLABORATION IN CREATING A WIRELESS POWER STANDARD**

Wireless power is a lifestyle technology. Like Bluetooth and Wi-Fi, it radically changes the way people are able to live their lives, offering new levels of mobility, convenience and safety.

Wireless power is a lifestyle technology. Like Bluetooth® and Wi-Fi™, it radically changes the way people are able to live their lives, offering new levels of mobility, convenience and safety. It has the ability to add value and create greater flexibility in the development and use of products across a wide range of power needs and industries. As such, it is imperative that a standard application of the technology be introduced to create the greatest opportunity for mass adoption and integration into consumers' lifestyles. Questions on the possibility of a universal standard that will allow consumers a convenient source to power their devices without the

inconvenience of adapters and power cords, no matter what the brand, are at the front of the wireless power conversations happening around the world, and without a universal standard, this will continue to be a challenge.

In addition to the challenges connected with individual organizations developing proprietary solutions, the number of market segments represented across the various power levels is another significant factor that must be considered. It is clear that technology is needed to bridge a broader range than each individual manufacturer would normally expect. The concept that a 60 watt power supply could power anything under that wattage and supply the proper device requirements was previously seen as costly. With the advent of advanced, low-cost power supply technology, this possibility is becoming reality. The adoption of this philosophy needs to align with consumers' expectations. If pursuit of a universal standard is not made the highest priority, it could certainly limit the widespread adoption of wireless power technology.

In addition to addressing questions on the feasibility of a universal solution, the cooperative development of a standard also addresses other key issues that could threaten widespread adoption of wireless power technology.

The most prominent of these is the "Chicken or the Egg" issue, which poses the challenge to manufacturers on when to invest in wireless power technology. Device manufacturers want infrastructure in place before they commit to mass production of their products, and infrastructure manufacturers want devices to use with their products before they commit to mass production. Both are valid concerns. By working independently on proprietary solutions, this question creates a potential stalemate that could delay implementation of the technology for years. Through cooperative efforts both device and infrastructure manufacturers will reach solutions that achieve their mutual needs. Additionally, by coordinating development and production activities, manufacturers will be better positioned to respond to the actual consumer demand for an integrated, interoperable solution. Taking these thoughts into consideration, in the end, it seems obvious that devices need to be manufactured to enable infrastructure. However, consumer pull based on acceptance will ultimately determine the magnitude of industry adoption and timing of entry into the market space.

In addition to the "Chicken or the Egg" challenge, there are other equally important considerations that can be addressed by the cooperative efforts of a unified wireless power industry in pursuit of a global standard. Supply chain development and production costs are significant factors that can have a potentially negative effect on integration of the technology. Only when key contributors bring their collective capabilities and solutions to bear will wireless power be able to realize its immediate potential. By working with chip set manufacturers and developing design solutions collectively, issues like cost of implementation, safety, efficiency and environmental effects can all be mitigated and create an environment in which wireless power can flourish.

### THE ECOUPLED™ SOLUTION

Like the model established by the Wi-Fi Alliance, Fulton Innovation (Fulton) has been working closely with a wide range of partners, including the Wireless Power Consortium, market leaders in every major electronics segment and other wireless power companies, to create and drive a global standard for wireless power. Initially, the standard will be established for low-power applications (5 watts and less). However, Fulton also has medium and high power solutions, creating new opportunities for companies to develop advanced applications, opening up the possibility of developing interoperable wireless power solutions across a broad spectrum of power needs and brands.

Devices	10% of annual income	Charge Power Watts	Standby Power Watts	Charge Hours/Wk	Standby Hours/Wk	Charge Power KW-Hr/Year	Standby Power KW-Hr/Year	Potential Savings in KW-Hr @10%
Phones	120,000,000	4	0.5	7	161	1.456	4.186	502,320,000
Laptops	15,000,000	45	0.5	14	154	32.76	4.004	60,060,000
Headsets	26,000,000	1	0.5	5	163	0.26	4.238	110,188,000
Cameras	12,500,000	4	0.5	4	164	0.832	4.264	53,300,000
Computer	20,000,000	2	0.5	7	161	0.728	4.186	83,720,000
Media Players	21,100,000	3	0.5	9	159	1.404	4.134	87,227,400
Camcorders	2,000,000	8	0.5	10	158	4.16	4.108	8,216,000
Total Annual KW-Hr @ 10%								905,031,400
Total Dollars at 0.08/KW-Hr								\$72,402,512

Note: Volume and usage data are provided as an example. The 10% is an estimated volume that could have 100% time plugged in.  
 Table 1: Example Impact of standby power in devices.

<sup>3</sup>Rose, William. "1394 Trade Association Technical Brief: How Green is My FireWire?" WJR Consulting, Inc.

Fulton holds over 400 granted, published, or pending patents world wide on wireless power development and applications, holding key technology in many areas, including medium and high-power applications, as well as in lower power delivery.

On that point, device standby power is a critical concern in the manufacture of power adapters and energy conservation and promises to be a key attribute in the development of wireless power solutions (see Table 1). Fulton uses a method called ultra-low standby power combined with efficiency comparable to wired systems

...device standby power is a critical concern in the manufacture of power adapters and energy conservation and promises to be a key attribute in the development of wireless power solutions. Fulton uses a method called ultra-low standby power combined with efficiency comparable to wired systems to minimize the power footprint of wireless power systems.

to minimize the power footprint of wireless power systems. By understanding the user habits of the charge cycles and powering of devices, Fulton has designed a system that looks at the total power used as well as the convenience of charging. This equates to looking at total power used. In some cases, the standby power is actually a larger power concern than the power consumption during use. Up to seven times the consumption can be used in standby versus normal operation. Research has shown that consumers do not want the inconvenience of disconnecting the power when power usage by the portable device has been completed. Ultra-low standby power automates this process. Systems working together to minimize power usage while providing a universal wireless power source are just part of what intelligent wireless power must accomplish. The chart below provides an example of how standby power can impact overall efficiency.

It should also be noted that the efficiency of wireless power is usually considered in the context of a basic wire configuration. In some cases this would be true, but typically, elements of the wall or source power supply, the connection and the device power supplies, chargers and power management will all play a factor in this comparison. This is why wireless power can be considered comparable to wired solutions. With ultra-low standby power, it can provide even more latitude for wireless power in this comparison.

Additionally, according to a I394 Trade Association Technical brief, “the wall warts, also called ‘energy vampires,’ provided with so many electronic devices are often linear power supplies, which are approximately 30-40 percent efficient. That means that they waste up to 70 percent of the power being used by the device they are connected to. Unfortunately, when the device is turned off, it continues to consume power.” The effect of this wasted energy can be felt not only in the inefficiency of the wall warts, but also in the environmental impact of disposing of them. In 2008 alone, 3.2 billion external power supplies were manufactured worldwide,

Product	PJ*	Metric Tons of CO2	# 1000MW power plant
Cell Phone	21	4,200,000	0.7
DECT Phone	5	1,000,000	0.2
Digital Camera	2	400,000	0.1
Set Top Box	5	1,000,000	0.2
Personal Care	1	200,000	0.0
Std. Battery Charger	3	600,000	0.1
Power Tool Charger	4	800,000	0.1
Printer	4	800,000	0.1
Laptop	2	400,000	0.1
Other	10	2,000,000	0.3

Table 2: Total Energy for Production, Distribution, End of life CO2 Generated by Coal

with 737 million external power supplies shipped to the U.S. Moreover, 434 million external power supplies will be retired in the U.S. alone and only 12.6 percent of them will be recycled, leaving 379 million external power supplies going into landfills (see Table 2). These devices don't just go away either. According to the EPA "these power supplies are made with toxic materials and don't have a lot of salvageable components making them unattractive to recyclers."

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In addition to the development of key IP across low, medium and high-power applications, Fulton has developed relationships with market leaders in the areas of chip set development, innovative product process and materials development, supply chain and distribution channel management and, with the Wireless Power Consortium, collaboration on a wireless power standard.

Fulton's commitment to creating the best possible solution for mass adoption by consumers worldwide is an open invitation to all electronics manufacturers, wireless power developers, institutions of higher learning, governing bodies and any other interested parties to join in the development and dialog needed to drive integration of wireless power across the myriad applications of power delivery across the planet.

## CONCLUSION

Wireless power is an exciting new frontier, opening up new possibilities for manufacturers and consumers around the world. This new frontier will have a major impact on many significant market segments and product design; in addition, it will provide environmental savings, simplify human interface with infrastructure and create new ways to interact with design of both devices and complementary products. As this technology reaches its tipping point and realizes mass adoption with consumers, it is imperative that engineering and design teams, wireless power solution providers, manufacturers and governing bodies collaborate closely to insure that a universal, interoperable solution that meets and anticipates immediate and future consumer needs is always made the first priority. Only by doing so will universal power delivery reach its potential and make wireless truly wireless.



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David Baarman is the Director of Advanced Technologies at Fulton Innovation and the lead inventor of eCoupled™ intelligent wireless power technology. Mr. Baarman is responsible for the technical supervision and development of eCoupled technology and other Fulton Innovation technologies.

Mr. Baarman joined Amway in 1997, where he first pioneered the use of intelligent inductive coupling in the eSpring™ Water Purifier. With over 20 years of leadership experience in the development of consumer and industrial products, Mr. Baarman took the technology behind eSpring and developed it to power everyday technologies, including consumer electronics, with a diverse range of power needs.

Mr. Baarman's efforts have led to national and global recognition of eCoupled technology and the acquisition of former competitor, Splashpower, in May 2008. Mr. Baarman has more than 350 U.S. and foreign patents that are granted or pending.