

Movers and Shakers Interview Fulton Innovation LLC

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Fulton
I N N O V A T I O N



eCoupled™ wireless technology from Fulton Innovation LLC

eCoupled™ is an intelligent wireless technology developed by **Fulton Innovation LLC**, a member of the **Altacor Inc.** family of companies. Fulton Innovation is a company that is dedicated to the promotion and commercialization of new and innovative technologies for the global marketplace.

Vishal Sapru (VS), Industry Manager for the Power Systems Group and Anu Cherian(AC), Industry Analyst with the Power Systems Group had the opportunity to interview Fulton Innovation (FI) about eCoupled Technology. Here are some of the key discussions in the interview.

(VS): eCoupled Technology, as your website states, is “intelligent wireless power”. Could you, in a few words, introduce the company as well as the markets that you consider as primary targets for the company?

(FI): Let us start at a very high level and then work into some of the details of that question. Fulton Innovation is a new division within the Altacor family of companies. Altacor is a \$6.5 billion company based in Ada, Michigan near Grand Rapids. You might know Altacor as the parent company of Amway. Fulton Innovation was formed over a year ago to license the new and innovative technologies that we have developed in the Advanced Technology R&D departments within Altacor. So, Fulton Innovation is a licensing organization and a technology solutions provider. One of the technologies we developed internally is a wireless power delivery method that we have trademarked as “eCoupled”. It was developed, tested, and incorporated into one of Altacor’s eSpring™ water purification systems to allow for the elimination of cords and connectors, simplify design, increase reliability, and lower production costs. The technology is very disruptive and revolutionary since we see applications in virtually all industries that use power. Some are more obvious than others. To eliminate cords, connectors, and improve the safety of power delivery to a variety of devices, eCoupled Technology is basically, as our website states, “intelligent wireless power”. It is based on inductive coupling which has been around since the late 1800’s. While inductive coupling itself is not necessarily new, what is new is the way that we identify, seek resonance, and adapt power delivery to optimize power transfer and maximize efficiency. Using our advanced knowledge of electronics and electromagnetic properties, we can provide power from a primary power source to a secondary device at efficiency levels never before achieved. Fulton Innovation has roughly 200 patents around eCoupled technology - 60 in the US now and over 200 internationally. We had 20 new patents in the first half of this year alone. We continue to expand the breadth and depth of the technology because much of its advancement is based on our own testing, experience, and design knowledge. The technology, as we discussed, is very adaptable and can be applied to a wide range of design solutions across dozens of industries. Consumer electronics would be one example of a very large industry (a couple \$100 million in the US alone) and, in that application, we are looking at a new universal ubiquitous way of providing power without cords or connectors to a variety of devices and within ecosystems where interoperability is important. We want our cell phones, PDAs, music players, digital cameras, and GPS devices to move seamlessly from our homes, to our cars, to our offices, and have them charge or power directly as we move across these environments. In an ecosystem such as your car, you might have a universal charging platform

built into the glove box or armrest whereby you could simply drop a variety of devices into it and have them all charge simultaneously. So, in multiple environments, we can provide power universally to a variety of devices.

(VS): Is it still in the implemental stage or have you implemented it? What, in your opinion, are the opportunities for this technology?

(FI): As we stated previously, the technology was originally deployed in our eSpring water treatment system approximately six years ago and that product is currently being sold in 36 countries around the world. It has been certified for safety worldwide, meeting or exceeding CISPR 14 and 22, FCC Part 15 and EMI requirements. We have sold well over 1.5 million units around the world. So, we have over 10 years of development experience and we have had an eCoupled-enabled product in the market for over 6 years. Our particular design challenge was that we needed to power a light bulb enclosed within a carbon filter that had water flowing through it. As you know, water is very corrosive to exposed metal and harmful to electrical connectors so we decided to investigate ways to completely seal the bulb from exposure to water. The water initially goes through the carbon filter in order to remove any large particles and then, in order to insure that the water is completely safe, we use an on-demand UV bulb to kill any potential microbes or bacteria which might remain in the water. Utilizing eCoupled technology, we are able to connect through half an inch of plastic and air to energize a UV bulb and disinfect the water in real time without any connectors. That was the original embodiment of the technology, but what we're doing today at Fulton is taking that core technology and implementing it in a variety of charging and power delivery applications. In the consumer electronics industry, we have mentioned our partnership with Motorola for cellular telephones. We are also working with a number of industry leading companies in the automotive infrastructure industry and Herman Miller in home office infrastructure. In the consumer electronics area we are working with an assortment of companies to develop interoperable standards with the ultimate goal for eCoupled to become the international standard for wireless power delivery. eCoupled is flexible and scalable and, because of these characteristics, it is able to satisfy a wide range of industry specifications. We are also working in a variety of other areas with companies that, due to confidentiality agreements, we cannot mention publicly. However, you can imagine the tremendous value in applications such as implantable medical devices. Pacemakers and cardio defibrillators are powered by batteries which must be replaced every four to five years. Simply replacing these batteries requires another expensive and painful surgery. Incorporating eCoupled technology into these devices could allow for extended battery and device life and result in a reduction in the number of these potentially life-threatening invasive surgeries. Patient monitoring systems, infusion pumps, and other devices used in hospitals where maintaining a sterile environment is critical, are also logical applications for eCoupled technology. Another big application we see is in lighting – in both

commercial and consumer lighting applications eCoupled technology can eliminate the exposed connectors and thus minimize the risk of shock. In the automotive industry, there are a variety of applications in the electronics itself that keep the automobile electronics functioning efficiently. In the appliance industry, particularly in the kitchen and home appliances, one area we are working on is the kitchen of the future where, if you have a hotspot or power point on your kitchen countertop, you can simply grab your appliance from a storage cabinet and set it on the counter to power it up and use it. Then, when you are done, you can simply toss it in the sink or dishwasher to clean it because the electrical components are completely sealed. You might have multiple eCoupled hotspots around your kitchen so you can eliminate the outlets and cords and use multiple devices simultaneously. We really are working in a very wide range of industries with a collection of industry leading companies who are interested in this technology. While our ultimate goal is licensing eCoupled technology, a large part of what we do in working with our partner companies is supplying our unique design know-how and technical support to develop solutions to integrate the technology into their products. So, there is a technology transfer implementation phase whereby we work closely with our partners to insure their specifications are being met, followed by a production and a licensing phase.

(VS): You call it a “disruptive innovation”. What are the specific applications that have currently incorporated your products and how is its adoption in the industry?

(FI): It is pretty disruptive and significant in two applications. One is delivering power directly, and the other is the charging application whereby you have an integrated power source. As you know well, in charging applications the device capabilities and the power demands continue to exceed the ability of current battery technology to provide more capacity. So, we actually see an increased need for technologies like ours and one of the concepts that has arisen is the concept of “charge snacking”. Because you want your devices to be powered throughout the day, you want this ubiquitous form of power so that, when you get into your car, you top off you device batteries. When you go to your office, you top them off again. When you go to the airport, you top them off for when you are traveling. So, with the increased power demands from electronic devices, we see a greater need for this ubiquitous, easy-to-use means of efficiently providing wireless power throughout the day. Beyond that, with the increased focus on the environment and reducing energy waste and landfill waste, we see a strong and ever-increasing consumer demand for this efficient technology as well. When we get into the details of the technology, some of those reasons will be obvious.

(VS): What are the specific applications that have currently incorporated your products and what feedback have you received from your customers?

(FI): Working with our partners, we have developed proofs of concept and completed dozens of design of experiments to demonstrate that the technology can satisfy their stringent requirements and the feedback we have received has been extremely positive. Additionally, what is very exciting to us is the consumer pull for this technology. If you talk with people who are heavy users of consumer electronics, they are all dying to get rid of the overloaded power strips full of cords, connectors, and chargers which become obsolete and wind up cluttering our drawers or, worse yet, dumped into a landfill every time they buy a new device. They want to be freed from having to pack and carry a nest of power cords and chargers to connect all of their electronic devices when they travel. We know from our research about power supplies that there is a huge customer demand to develop a universal solution. So, we found that there is a very strong consumer pull to implement and eliminate those cords and connectors and we believe our technology is the best solution to make that standardization a reality.

(VS): When do you plan to go commercial on this?

(FI): As we already said, the technology itself has been on the market for almost seven years. Our business model is to partner with a variety of strategic industry-leading companies across a wide range of industries to incorporate the technology into a diverse number of applications. Because the application possibilities are nearly endless, we believe adoption will be an ongoing process for many years and we believe eCoupled technology will become ubiquitous. It will be a new era of providing power without wires. We believe eCoupled™ is the Bluetooth™ of wireless power, the Intel™ inside of wireless technology. That is where we see this going.

(VS): What are the challenges you face currently and foresee in moving your technology ahead?

(FI): We think that, in the consumer electronics industry, interoperability in building standards across such a diverse range of companies and devices presents a bit of a challenge. If you take a look at the wide range of device configurations all with differing power demands just within one company, you can quickly see the complexity of this issue. We are addressing that challenge through a consortium of leaders in their respective areas to initially develop a de facto or reference specifications to a de facto standard to ultimately a standard. We are the only company taking the long-term view by bringing together a group of companies to develop interoperable solutions together.

(VS): Do you currently have any kind of competition in the market? If so, who are they?

(FI): There are similar technologies out there, but nothing that has the capabilities that eCoupled has. We have to get into the technical details to answer that question completely. Many of the companies talking about

wireless power do not use inductive coupling. Because of this, we believe these alternative technologies have some significant challenges to overcome and limitations in terms of widespread consumer acceptance. So, from a Fulton Innovation standpoint, one thing that differentiates us from others out there, and one of the most important aspects of eCoupled technology that makes a difference, is our format and intelligence. It is really intelligent inductive coupling. Your cordless toothbrush is very unintelligent. You have a fixed base, very low power levels, and a very inefficient implementation. There are several aspects to eCoupled intelligence. One aspect is that it adapts and it optimizes operations of the secondary load and it does that in real time. What that means is that it maintains the level of efficiency as the load changes. For instance, if your battery is initially totally drained, when you start charging it, you really pump a lot of wattage into it. With eCoupled technology, we analyze the charge profile of the battery and transfer the optimal amount of energy in the most efficient manner. It does this by constantly changing the operating frequency to seek resonance and adjusts the power transfer respectively. Tightly coupled primary and secondary coils maximize the amount of power that is transferred. It is much more efficient than any other competing technology. Some competitors you'll hear about are Splashpower - a UK-based company. They are using another form of inductive coupling. Wildcharge has been getting a lot of press lately. They do not even use inductive coupling. They use an exposed contact-based solution to put multiple devices on a charging plate, providing power in the 5 to 10 watt range. They are targeting consumer electronic devices exclusively. There is also a company called Powercast which has the ability to send power through a 900 MHz frequency, harvesting the energy in radio waves. It provides very low level power, trickle charging at micro or milliwatts depending proximity and a few other variables. MIT is generating a lot of interest in something they are calling "WiTricity". We did some research on it, but it is a very experimental technology with significant tradeoffs right now. Basically, there is nobody directly competing with us at this time.

We are continuing to work with industry-leading companies as a technology provider to apply eCoupled technology to a wide range of applications in industries and, to do that, we continue to evolve and develop the technology. This year alone we have been awarded 20 new patents in the first half of the year – which will bring our total to over 200 patents by the end of the year. We continue to expand the nature of our technology to incorporate it into more and more applications.

(VS): Do you target primarily the North American market or the international market?

(FI): Both domestic and international markets. Our technology is applicable anywhere power is used—either directly or indirectly through charging. Most of our partners are multinational corporations.

(VS): What are the channels do you use to bring your product to market? Are you direct marketing or distributors or through OEM's?

(FI): We are licensing to manufacturers of platforms and devices which will have eCoupled technology embedded in them. For example, if you look at the cell phone industry, Nokia, Motorola, Samsung, LG, and Sony Ericsson hold 90 percent of that market. So we will be working with those kinds of companies to integrate the technology into their products. With digital music players, we are looking at Apple, Microsoft, and Sanyo. The appliance industry is bit more of a fragmented market, so there are many companies we are working with.

(VS): Is your product available for purchase only with specific devices as specific chargers or as a generalized gadget that has the ability to charge multiple devices like the cell phone and laptop at home?

(FI): It could be designed in multiple ways and here it is important to understand the technology. Our technology has the ability to have quite a bit of positional freedom. So, in theory, you can have a primary coil and you can have multiple devices powered by a single primary. In reality, we have found it is a better design to have more of a one-to-one relationship where there is one primary coil and one secondary coil. That is because one-to-one configurations are much more efficient. You can imagine if you are trying to power multiple devices with one coil and you have a magnetic field that is not being coupled, there is just a waste of energy. And, particularly in consumer electronics applications, you are trying to keep to the proximity of batteries of other devices, you want to make sure that the devices are coupled very tightly to maximize efficiency, minimize noise and harmonics which might impact other communications. So, by the very nature of electromagnetic coupling and to maximize that coupling through resonance-seeking, using a one-to-one coil relationship has become the design that works very well. But certainly it can be designed where one surface charges or powers multiple devices. Another technique to doing that would be to incorporate multiple coils in the charging surface and that it where we get into the fact that eCoupled technology has built-in profiling and identification intelligence. The technology has to be designed to know when to provide power but, even more importantly, when NOT to provide power. Some of the competing technologies have a charging pad which is always on and drawing power. You could set multiple devices on this pad because it is always developing a uniform magnetic field. By definition, if there is nothing on the pad, you are just consuming energy and efficiency is zero. But most importantly, what happens if you put something on that pad that isn't supposed to be charged like a piece of metal, a handful of change, or a device that wasn't designed to be charged; this could be dangerous or cause damage to devices. eCoupled technology has a way of uniquely identifying an eCoupled-enabled device and, if it doesn't see a device it recognizes, it doesn't turn on at all. That same technology could be used to

recognize a device and determine physically where it is located on the charging surface and to choose which particular coils activate to deliver power. We do have an embodiment where we charge multiple devices on a single charging surface and we optimize that power transfer through the intelligence of the technology. The downside of that embodiment is that it adds a lot of cost. And again, in consumer electronics applications, cost is an important design criterion—especially for the solution with the one-to-one coil configuration. It is not an aspect of the technology, but it is more of a market need that is driving the design. In a home charging application we have a design that is more of a cradle and you can set your device that sits upright in a cradle and it charges. Or, something that looks like more of a mouse pad and that mouse pad has multiple hot spots on it. So, depending on the nature of the device and the size of the device, you can have multiple coils and charge multiple devices at once. It might be multiple devices on a single charging base so that only when those devices are present are you consuming power. When no device is in range, you are not consuming power and you are not generating noise.

(AC): What is the maximum distance between the primary and the secondary circuit for charging? What kind of proximity are we looking at?

(FI): Inductive coupling, by its nature and the pure physics of it, is good for transferring power over inches—not feet or meters. This is not an MIT technology or a Powercast technology where they are talking about sending power over long distances.

We use a near-field configuration which is extremely safe and efficient where those other technologies are, by their very nature, very inefficient. For a variety of reasons, we see efficiency as very important. We are typically transferring power from primary to secondary within inches of each other. With many devices we are going through varying thicknesses such as between a countertop and the plastic housing of your cell phone.

(VS): Are there likely to be any partnerships or exclusive agreements made with eCoupled technology to market your product?

(FI): We are working with a number of industry-leading companies and the issue of exclusivity or non-exclusivity is dependent on the specific application or market segment. Yes, some of our arrangements are exclusive and some are non-exclusive so it just depends. Generally, we believe that long-term and non-exclusive agreements are the best answer for widespread consumer adoption of eCoupled technology. In the short-term, we are willing to entertain exclusivity in order to accelerate rollout to the marketplace. In some cases, a company is willing to make the investment as long as they have some amount of protection or exclusivity in the marketplace. But, in order to become a truly ubiquitous interoperable

solution, our partners agree that we need to have non-exclusive standardized solutions.

(AC): What kind of efficiency are we talking about in terms of power loss over a cord versus this wireless charging technology?

(FI): The efficiency depends on many factors. Spatial freedom, coil design, and power levels are some of the variables. The technology is capable of being extremely efficient. For example, in the kitchen of the future application, we are delivering 1,500 watts through a kitchen counter at 98.6 percent efficiency—and that is not coupling efficiency but total system efficiency. So, the technology can be virtually identical to a plug and socket connector configurations. It gets a little more complicated to answer that question when you talk about comparing it to a variety of switching power supplies. In existing switching power supplies, efficiency varies greatly based on the load, because they don't adapt. You might have a power supply that is rated at 60 or 80 percent, but that might only be true if you are charging a completely depleted battery. In battery charging, efficiency matters. In many cases we can be equal to or more efficient than switching power supplies because of the adaptive nature of the technology. Some of the issues in efficiency have to do with lower voltage devices where there are some system limitations in the components of the devices or switching power supply.

(VS): Where do you see yourself this year and what is your roadmap for the future?

(FI): We believe eCoupled technology is the Bluetooth of wireless power. We have cut the cord on everything else, and this is the last cord left to cut. We believe that eCoupled will provide the infrastructure and the technology to cut the last cord. That's true in a variety of applications. Our vision in the consumer electronics world is a universal form of providing wireless power for a wide range of devices. Within the next year or two we will believe our technology will be pervasive in the industry.

(VS): In conclusion, would you like to make any concluding remarks to our readers across a spectrum of industries?

(FI): There are a couple of things we did not quite touch on. Among all the other technologies out there, eCoupled is unique because it is very scalable and adaptable and it provides universal power. We can provide power from milliwatts to Kilowatts. We can easily do 1,500 watts in a kitchen appliance application, but theoretically we can go much, much higher. Many of the other technologies out there are designed to do 5 to 10 watts or, at the most, up to 100 watts. But no one else is talking about milliwatts to Kilowatts. That is kind of an important note to our technology.

The other question that always gets asked is about safety. eCoupled technology is very safe. We are operating at very high frequencies—

somewhere in the 100,000 Hz range and, even if you put a credit card in the path, it will not be affected. From an interference standpoint, we are safe again because we are seeking resonance in a tightly coupled near-field configuration so there are limited harmonics. Because it is so efficient, there is less noise. We are eliminating physical cords and connectors so the physical risk of tripping over a cord or connector is eliminated. Additionally, the risk of electrocution due to moisture on the connections is virtually eliminated because there are no longer any exposed connectors.

Compared to other technologies, eCoupled is unique in its universal nature whereby a single primary can cover a wide range of secondaries. We can power a wide range of lighting equipment all the way from 12 volt halogen bulb in your car up to the 1000 volt UV bulb for specialty lighting with the exact same power supply. In power tools, we can power anything from a 9V all the way up to a 36V rechargeable battery—all with the same base charging technology. So, it is a universal power source which is very unique. In addition to providing power in a wireless mode, we also send data wirelessly which is very important for everything from simple control information such as when the battery has reached the right voltage to very detailed information such as temperature or battery life cycle. So we can do that at over 3Mbps and Fulton Innovation is the only company with that kind of power and data together.

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