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“I Have No Strings . . .” Key Legal Issues Relating to Wireless Charging Technology

Paul Keller and Susana Medeiros*

This article first describes the science behind wireless charging technology, and from there discusses the U.S. legal and regulatory challenges facing this technology.

In 1891, Nikola Tesla invented an electrical resonant circuit known as the Tesla coil that could wirelessly transmit electrical energy into stunning displays of light and color. Today, consumers can take advantage of wireless chargers and may do so with increasing frequency for their vehicles, devices, and perhaps their entire homes. As highways and homes become charging stations, the legal issues concerning this technology expand significantly. Both industry leaders and regulators will have to consider how wireless charging technologies will be affected by various legal areas, including products liability, data privacy, cybersecurity, and intellectual property. This article first describes the science behind wireless charging technology, and from there discusses the U.S. legal and regulatory challenges facing this technology.

Wireless Charging Technology

Wireless charging devices currently use one of two processes to create energy: (a) inductive charging to create energy over short distances, and (b) radio frequency charging to create energy over long distances.

Inductive Charging

Wireless chargers may employ a process known as inductive charging, which creates an electromagnetic field to transfer energy from a wireless charger to a battery-powered device. A wireless

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charger contains an induction coil that creates the electromagnetic field, and the battery-powered device contains a secondary coil that draws power from the electromagnetic field, converts this energy into an electric current, and uses the current to charge the battery within the device, as illustrated below.

Most inductive charging only works within small distances (one to two inches). Hence wireless chargers for smartphones often require the phone to be placed directly on the charging platform.

Inductive charging can work for longer distances of up to six feet by ensuring that the coils contained in the wireless charger and the battery-powered device operate at the same resonance, or frequency, as each other. By syncing resonance between coils, the charger can increase the amount of power, and the efficient transfer of that power, between the coils, allowing the device to be charged more quickly, and at greater distances. The efficiency of the charging, however, drops as the distance increases. Because this technology employs resonance, it is typically referred to as resonant inductive charging, or merely resonant charging. The Tesla coil transferred energy by resonant induction.

Because resonant inductive charging does not require direct contact, the charger can be placed beneath the surface of an object, such as a kitchen countertop or an armchair, and transmit energy through stone, glass, concrete, or wood.

Resonant inductive charging is essential to charging larger devices, such as electric vehicles. Wireless charging of electric vehicles is achieved by burying charging plates beneath portions of a road to create a rechargeable highway that charges the battery within the electric vehicle. This technology has been powering select bus routes in South Korea, Germany, Italy, the Netherlands, and Utah for several years.[1] Other applications may include chargeable parking lots, driveways and garages, and even chargeable docks for marine vehicles.[2]

Radio Frequency Charging

Whereas Wi-Fi uses radio waves to provide wireless internet connectivity from your router to your internet-enabled devices, some wireless charging devices employ radio frequencies to charge your phone over distances of two to 80 feet—a great deal farther than inductive and resonant inductive charging. Because great distance comes at the cost of power, however, radio frequency charging will likely focus on powering low-power devices such as game controllers, keyboards, headphones, and basic smart home devices, rather than power hungry smartphones.

Law and Regulation

The Impact on Radio Airwaves

In the United States, the Federal Communications Commission ("FCC") regulates devices that emit energy on frequencies within the radio frequency spectrum. Although wireless inductive charging and wireless radio frequency charging work differently, both technologies emit energy within the radio frequency spectrum. Therefore, wireless charging technologies must receive approval from the FCC before manufacturers can market their chargers commercially. The FCC evaluates charging technologies to ensure that these devices are operating within a restricted radio frequency and at a restricted power level, and to prevent potential interference between different users.

Wireless charging devices have the potential to proliferate in every area of life, from the home and workplace to public spaces. The pervasiveness of this technology could cause bandwidth issues as more and more devices operating within the same radio frequency spectrum cause the spectrum to overload with interference. Such congestion already has prompted the FCC to open up "white spaces" or radio frequencies that have fallen into disuse. The radio spectrum is not unlimited, however, and congestion of the radio spectrum is likely if wireless charging technology becomes very popular. Radio interference could be more than a mild inconvenience—it is more dangerous when an electric car runs out of charge than when a phone does.

Wireless Charging Technology and Electric Vehicles

Regulators may consider whether to recommend certain safety features for wireless recharging technology. Additional safety features may be appropriate in heavily regulated spaces such as the automobile sector. Just as the federal government mandates seatbelts, it also may propose standards for adopting safety features in electric vehicles that conserve energy in low battery scenarios. Safety features could include dimming in-vehicle lighting, turning off nonessential systems, or creating a reserve or backup battery power for use in low power, emergency conditions. In the autonomous electric vehicle space, regulators could work with industry leaders to determine whether a vehicle should take a specified action in low battery scenarios, such as selecting a more efficient route to a destination (as opposed to a toll-free route), or rerouting to the nearest charging station.

Numerous states have instituted emission standards for vehicles, and require regular inspection checks. Similarly, the federal or state government may institute battery inspections to ensure that electric vehicles do not contain aging or inefficient batteries. Battery inspection would likely protect against problems associated with aging or defective batteries, including overheating, fire hazards, and the inability to hold a charge.

Regulators also will have to consider new partnerships between government agencies in the wireless charging space. For instance, as electric vehicles become more prevalent and charging technology gains mass appeal, it may be appropriate for the FCC to work in conjunction with the Department of Transportation to regulate vehicles and highways.

Wireless Charging Technology and Consumer Electronics

Outside of the electric vehicle space, regulators could build on existing safety guidance and standards for batteries used in consumer electronics in the context of wireless charging technology. Currently, the Federal Consumer Protection Safety Commission ("CPSC") has adopted numerous voluntary standards for manufacturers of rechargeable batteries and manufacturers of devices using rechargeable batteries.[3] The CPSC published a 222-page report in February 2018 on high-density batteries, which are often rechargeable, detailing its past and ongoing efforts to improve battery standards and reach out to manufacturers about responsible battery applications.[4] The CPSC further stated that manufacturers of end-product systems such as chargers should design them to address thermal protection and charge and discharge protection.[5] The CPSC should reevaluate current voluntary standards as wireless charging technology develops, with input from industry leaders.

Product Liability

Safety Features

Manufacturers could consider whether to incorporate various safety features into wireless charging technology, either on a case-by-case basis, or on an industry scale. For instance, the Wireless Power Consortium ("WPC"), an international technology consortium of industry leaders seeking to promote one wireless charging standard, developed Qi,[6] an interface standard for wireless technologies employing inductive charging and resonant inductive charging technologies. Qi, and similar interface standards, allow chargers and battery-powered devices developed by different manufacturers to interface with each other as long as they are Qi compliant. Through Qi, the WPC has been able to develop some of the first safety features for wireless chargers. For instance, the WPC requires manufacturers of Qi-certified chargers to conduct testing with an authorized test lab to ensure that the chargers do not overheat or induce an electrical voltage that could damage the battery-powered device. Industry leaders should continue to develop testing and safety standards to ensure that wireless chargers are safe for consumers and their devices.

To the extent wireless chargers are able to charge multiple devices simultaneously, manufacturers may need to determine which devices receive charging priority. Within an electric vehicle, workplace, or home, battery-powered devices that relate to basic tasks for work, entertainment, or safety, may all require charging at once. In a low power scenario for a wirelessly powered electric vehicle, manufacturers should consider which functions they can turn off (or leave uncharged) to extend battery life, and which battery-powered safety features should receive priority. Manufacturers may strike a balance between protecting the consumer and not unduly interfering with the consumer's autonomy. Consumers may reject some safety features if it limits their enjoyment of the device. For instance, manufacturers may want to design a program that in low power conditions will decline to charge other unessential devices *before* it declines to charge the battery-powered entertainment devices that consumers enjoy.

Manufacturers should also decide to what extent consumers may alter the charging priority programmed into their wireless charger. Consumers may seek to prioritize entertainment devices over safety devices. Manufacturers should also determine the extent and scope of any instructions or warnings provided to the consumer regarding charging priority features.

Health Concerns

Constant exposure to electromagnetic fields, which are emitted by wireless charging technologies, may be found to impact an individual's health. Generally studies have not found a relationship between cancer and exposure to low frequency electromagnetic fields, but some have argued that frequent workplace exposure to radio frequency emitting technology such as power stations and microwaves can create an increased risk of some cancers.

Manufacturers may want to determine whether it is appropriate to develop instructions or warnings directed to consumers on this issue or find ways to reasonably limit the level of energy emitted from these devices. As this technology improves and energy transfer becomes more accurate and efficient, this may reduce the likelihood of harmful exposure to the public. Chargers should also have a feature that can manually or automatically "turn off" the device and prevent generation of an electromagnetic field—in fact, this system is already in place in many wireless charging devices operating on the Qi standard. A Qi-compliant charger will not activate until it detects a Qi-compliant device is present.

Medical Devices

Resonant inductive chargers are currently in development to wirelessly charge medical devices.[7] For implanted devices, the benefits of a wirelessly rechargeable medical device is its permanence. For example, people with incurable heart disease often require a heart transplant. As the supply of donated hearts is low, patients must instead obtain left ventricular assist devices ("LVADs") that provide normal heart function. These devices are typically wired and battery operated, which means that patients with LVADs must have a permanent incision in their chest for the wire's path. These patients must avoid showers, and rain, or risk electrocution and infection. Using wireless technology could significantly increase the quality of life of these patients. Similarly for portable medical devices, wireless charging will eliminate the need for charger ports, and thus the devices are easier to sterilize, and create less of a tripping and electrical hazard in a crowded operating room.

The potential benefits of wireless medical devices are clear, but manufacturers of wirelessly rechargeable medical devices must continue to ensure that their technology is safe for medical use and human implantation. Use of low power, inductive charging for medical devices in the past has resulted in overheating of the device, but it is hoped that using resonant inductive charging will alleviate some of these concerns.[8]

Integration with Batteries

Charging technologies rely on batteries, which have had their own technological growing pains. As a battery's energy capacity increases, the release of that energy, if uncontrolled, may increase the chance of fires or burns. Batteries with a high energy density contain a significant energy capacity for their size, but are more prone toward overheating and combustion. Currently, lithium-ion and lithium-polymer batteries, which can be rechargeable, have a high energy density for a competitive cost. However, lithium-powered batteries have faced significant issues in the consumer marketplace, and the CPSC has issued recalls of these products in the past. Notably in the automobile sector, the March 23, 2018 crash of a Tesla vehicle resulted in a postcrash fire. After the fire was extinguished, the Tesla's lithium-ion battery, which was damaged in the crash, reignited multiple times.[9]

Privacy and Cybersecurity

The technology we use contains more personal data about us than ever before, and there is no reason to think that this trend will not continue.

Wireless charging may one day power our homes and everything inside of them: our stovetops and kitchen appliances; our entertainment systems and accessories. Wireless charging technologies will have access to what devices we use, and how we use them. Manufacturers may be able to calculate when and how often a consumer uses a battery-powered device by analyzing a battery's charge over time. Manufacturers would likely accomplish this analysis by comparing a battery's average rate of depletion without use against the actual rate of depletion. As a result, regulators, industry leaders, and consumers should be aware of the potential to data mine information about device usage.

As certain devices, such as smartphones and electric cars, are more likely to move with an individual, individuals may connect these devices to multiple charging devices over the course of the day—at home, work, or the local coffee shop—providing a personal map of where an individual is at all times. Wireless charging technology may inadvertently store information beyond what is necessary for basic function, such as personal health information stored on wireless fitness bracelets and thermometers, which could make this information vulnerable to hacking. Security measures must be put in place to protect personal data from hackers. But a legal framework must also be built to protect personal data from being maintained or used by manufacturers and regulators who may have inadvertent access to this data. Just as wireless internet is more vulnerable to third-party tampering than a wired connection, wireless charging, in particular wireless charging employing radio frequencies, may also be vulnerable.

Conclusion

Wireless charging technology may truly "have no strings," but its use will come with strings attached. As this technology grows exponentially in the consumer electronic field, and moves to expand into new industries, such as the automotive and medical device industries, industry leaders and regulators will need to consider attendant legal issues.

Notes

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1. *See* Keith Barry, "In South Korea, Wireless Charging Powers Electric Buses," *Wired Magazine,* August 07, 2013, https://www.wired.com/2013/08/induction-charged-buses/.

2. *See* "Wireless Charging for Ships: High-Power Inductive Charging for Battery Electric and Plug-In Hybrid Vessels," *IEEE Electrification Magazine,* Volume: 5, Issue: 3, September 2017, http://ieeexplore.ieee.org/document/8025701/.

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