



**RE
THINK
THE WAY
YOU
CHARGE.**

NXP

**WIRELESS CHARGING
DELIVERS SEAMLESS
CONVENIENCE & EFFICIENCY**



WHAT IF
ALL YOU
HAD TO
DO TO
DO TO
CHARGE
A DEVICE
WAS SET
IT DOWN?



Our lives are filled with **smart mobile systems**, small and large, designed to use an astonishing array of innovative features to help us move through the world in new ways. These various mobile devices enhance our experiences, making life richer, more engaging, more sustainable, and more productive.



And yet, despite all this innovation and seamless connectivity, there's one aspect of mobility that remains stubbornly the same – the way we recharge our battery-driven devices. By and large, we're still using the same cumbersome approach we've been using for nearly a century: power outlet, charging cord, plug.



That got people thinking. How might we bring charging up to date? How could we make it more in line with the rest of our intuitive mobile experiences? What if we could make recharging a battery a natural, hassle-free movement?

There had to be a better way. And, as with so many things these days, the answer was wireless. There are actually a number of wireless techniques for transmitting power – some work in far field, some in near field, and some need line of sight or can only transmit very small amounts of power. One technique in particular, however, is a good choice for powering a battery without using a wire. It's called inductive charging, and it's something

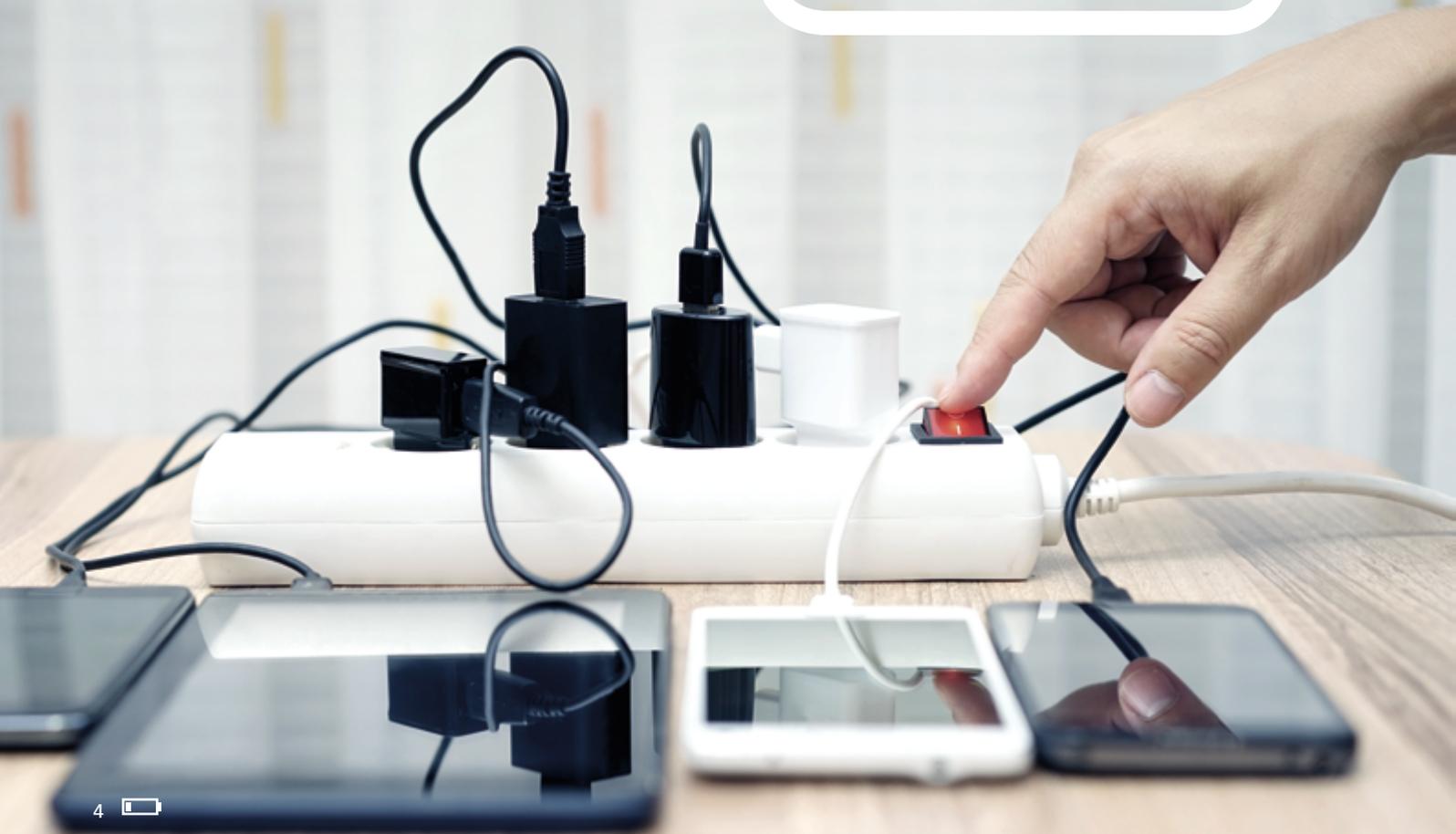
that's been used in consumer devices, like electric toothbrushes and other personal-care items, for several decades.

With inductive wireless charging, you just set your device on a charger and power immediately begins transferring to the battery. The concept is simplicity itself. There are no cords to plug in, no extra accessories to fuss with. A tedious task becomes effortless, requiring no more thought than setting down a coffee cup to signal your server for a refill.

Smartphones that use wireless charging are becoming relatively commonplace, but that's just the beginning. Now, with the latest formats of wireless charging, developers are able to create a whole new category of tiny products that don't use plugs or ports, so they're smaller, sleeker, and safer to use. It's taking convenience and efficiency to new heights, and creating better electronic experiences for everyone.



THE MANY PLEASURES OF PRESENT-DAY CHARGING

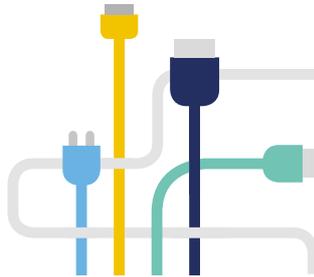


We're guessing that, if you're like most people, you've had one or more of these experiences with **battery-powered** devices



CLEAN WITH CARE

Your new smart watch is great. It tracks your heart beat while you work up a sweat and gauges your performance on that muddy mountain bike ride. Now it could use a cleaning, but there are no clear instructions. It says the device is water resistant, but does that really mean you can dunk it in soapy water?



ENJOY THE CABLE SALAD

Because so many devices use different plug and cable formats, you've acquired a messy collection of tangled up cords. Smartphone, laptop, digital camera, Bluetooth speakers, exercise tracker, wireless headphones – each one comes with its own charger. They all use surprisingly similar color schemes, have similar looking plugs, and just sit there, waiting for you to remember what works with what.



HUNT FOR BATTERIES

You just opened your latest purchase, or maybe you just gave a birthday present to your favorite niece. The manufacturer was kind enough to provide you with a charging cord, but neglected to include the batteries. Now you have to hunt some down or go to the store before you can start enjoying that new device. If it's after hours, you'll have to cannibalize another device and use its batteries to power this new one.



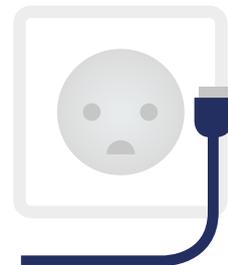
FUN WITH PLUGS AND CORDS

You left the house in a rush. You remembered your smartphone, since it houses your keys and wallet and other stuff, but you forgot your charging cord. Now you need more power, and you're out of luck. If only you'd thought to charge before you left! Or maybe you did bring a cord, but it's the wrong one. You ask to borrow a charger, but which type do you need? Some flavor of USB? Special charging pins? Proprietary? You'll need to find someone with



SURPRISE RASHES AND ALLERGIES

The special charger that came with your earbuds, fitness band, or smart watch delivers power through electrical connectors, called pogo pins, made of gold-plated nickel. What you find is that, with repeated use, the gold can scratch off and expose the nickel. The device's pogo pin then comes in contact with your skin. That's when you discover that you're in the 10 to 20 percent of the human population that's allergic to nickel.



GOOD LOOKS AREN'T EVERYTHING

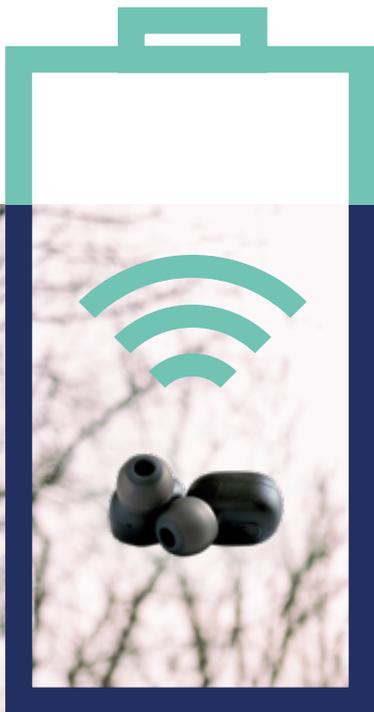
Everyone appreciates a sleek design, but today's charging technology can be difficult to streamline. Thick batteries, big connectors, unsightly plugs – it's hard to make a thin stylus pen, a tiny earbud, or a light set of AR glasses when you're stuck using bulky items like batteries, plugs, and cords to charge the device.



NFC AND Qi LET YOU RETHINK CHARGING

Two readily available formats of inductive charging – **Near Field Communication (NFC)** and **Qi** – can deliver power to a full spectrum of battery-driven devices, from tiny portable and IoT devices to kitchen appliances. Just set your device on an NFC or Qi-enabled charger and you're ready to run.

Whether you're using several short sessions over the course of a day or one long session, for an extended period or overnight, you get a top-up each time you place the device on the charger. Fueling your device becomes an intuitive, seamless part of your everyday experience.





NFC AND Qi ARE PERFECT PARTNERS

Just as there are several radio technologies that operate in the wireless spectrum for communication – such as cellular, Wi-Fi, Bluetooth, and, of course, NFC – there is more than one technology in the wireless spectrum for battery charging. NFC and Qi are complementary charging technologies that work in tandem to address a new generation of mobile devices.

NFC is an outgrowth of smartcard technology, which has used wireless energy

harvesting for more than 25 years. NFC works at the low end of the power spectrum by charging devices that operate at or below 1W, and with the aspiration to go beyond 1W in the future.

Qi, on the other hand, works at the higher end of the power spectrum, charging smartphones and other devices, including laptops and kitchen appliances, which operate at or above 5W.

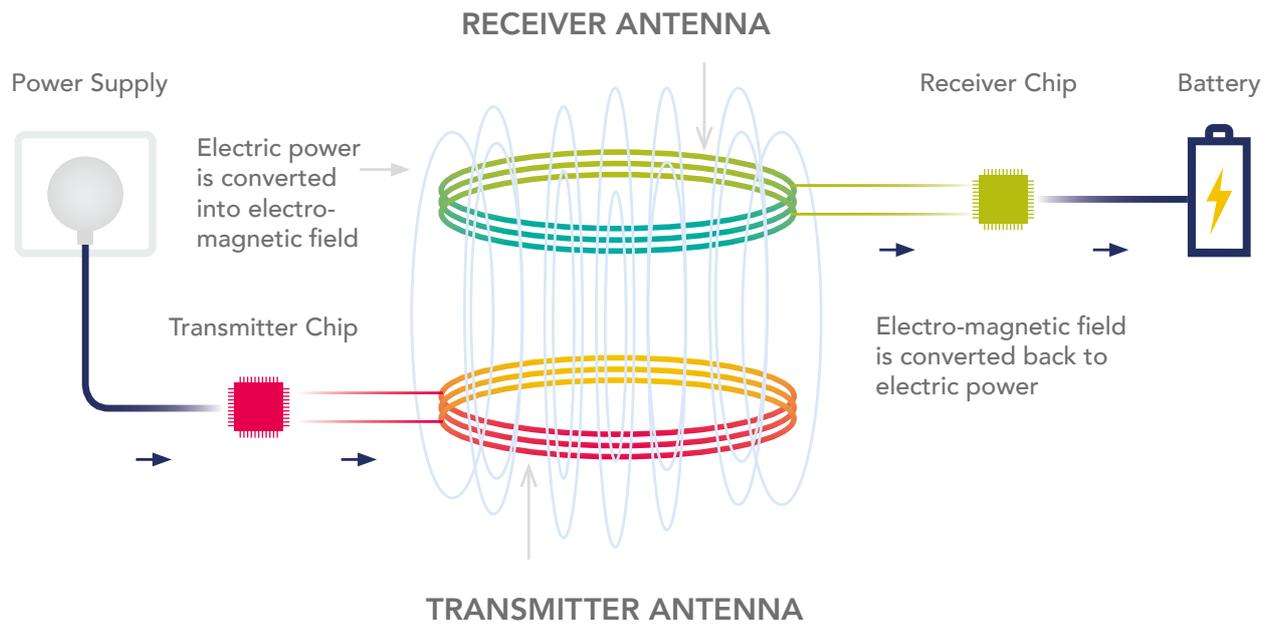


LOW POWER < 1W
Small Consumer & IoT Devices



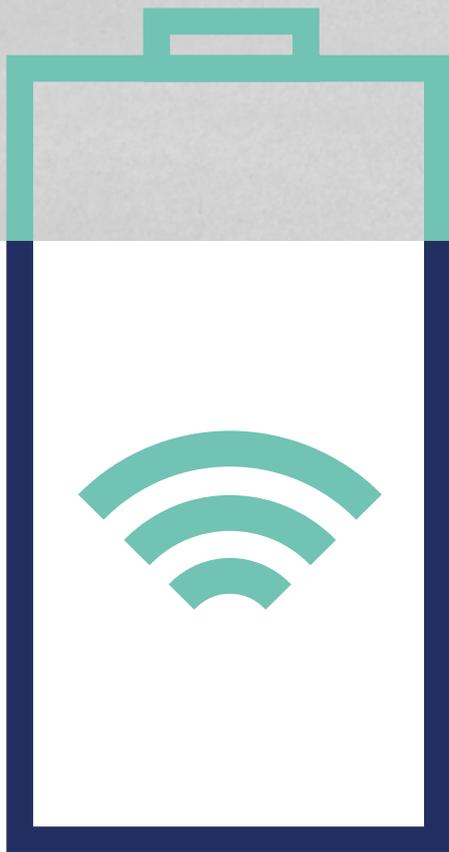
POWER LEVEL 5 < 2000W
Medium-High Power Devices

INDUCTIVE CHARGING USES RADIO WAVES TO SEND POWER



Wireless power transfer generally requires two antennas: a transmitter antenna (in the charging device) and a receiver antenna (in the receiver device). A shared (or coupled) electromagnetic field is generated when the transmitter and receiver antennas are positioned near each other. The shared field then wirelessly transfers power from one device to the other, sending energy to the battery. The process is safe, energy-efficient, and cost-effective to produce and operate.



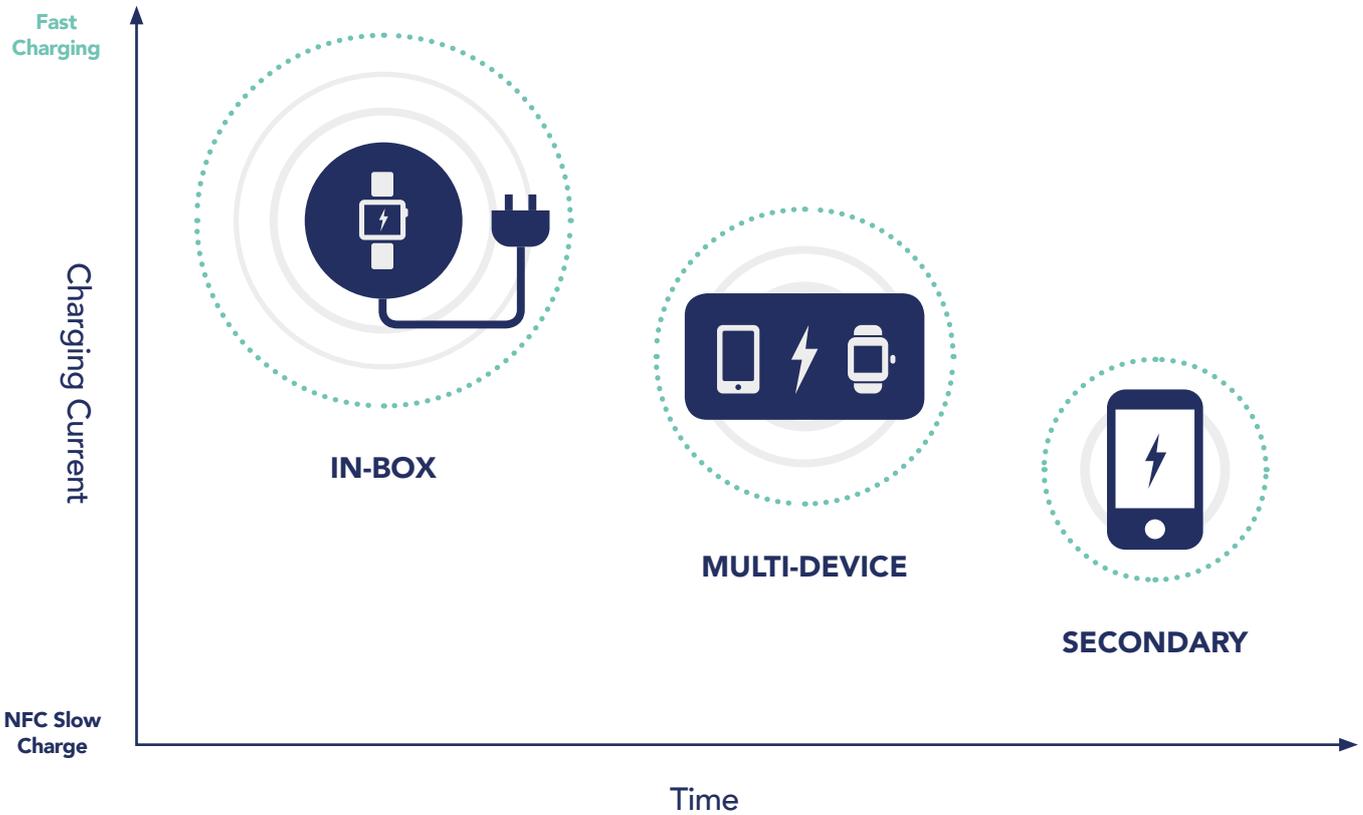


SET IT AND FORGET IT.

The arrival of **NFC** adds new dimensions to wireless charging. Not only does it power your device more conveniently than ever, NFC also makes charging more flexible, give designers new ways to make their products more streamlined, and helps manufacturers simplify production and lower costs.

NFC WIRELESS CHARGING IS DESIGNED FOR FLEXIBILITY

The 'Future' NFC infrastructure will enable flexibility in charging, so you can have it your own way:



NFC SLOW CHARGING

Let's you tab into widely available infrastructure and have a slower charge using the future NFC compatibility of a notebook computer or a smartphone, or other

FAST CHARGING

Delivers a quick charge using the in-box charger supplied with your device, in case time is critical.





NFC EXPANDS THE CONCEPT

NFC-driven wireless charging is designed for flexibility, with two ways to charge your device. You can use fast charging, which delivers a quick charge using the in-box charger supplied with your device, or you can use **NFC slow charging**, which delivers a slower charge - from another NFC device (e.g. smartphone) that is enabled for both communication and charging – to supply the charge.

NFC slow charging delivers unprecedented convenience. A small amount of energy, sent via NFC by another device, slowly recharges the device's battery. It's a concept borrowed from automotive, where car owners use trickle chargers to maintain their car's battery while it's in storage or slowly bring a dead car battery back to life. Now, with NFC slow charging, the idea of "low and slow" charging makes it easier to get a top-up, since you can get a recharge from just about any NFC portable device that is enabled for both traditional NFC communication and charging and you're likely to already have with you.

Let's say you find yourself out and about, and your earbuds are running low on energy. NFC slow charging lets you get a top-up by simply setting your earbuds on your smartphone while you do something else, like have lunch at a café or visit with a friend. You can easily get small charges throughout the day, without having to worry about remembering your dedicated charging device or finding a wall outlet. You can consume energy the way that's best for you – in a single charging session, every so often, or in short, more frequent charging sessions whenever the opportunity arises.



NFC FOR WIRELESS CHARGING GIVES YOU 5 WAYS TO INNOVATE



1. Seamless operation

Certifiable interoperability means devices charge as expected, regardless of origin, geographical location, or application.

2. Integrated data channel

Reliable, bidirectional communication enables firmware updates, mutual authentication, and data transfer.

3. No external interface

Personal-entertainment, fitness, and medical devices can be hermetically sealed, to prevent entry of water or dirt.

4. Efficient, negotiated charging

Devices can adjust and control the characteristics of the charge pad, so each charge uses the most efficient profile while also helping to extend battery life.

5. Global ecosystem

With close to 10 billion NFC-enabled devices and readers on the market, NFC represents one of the largest global ecosystems. NFC charging is an extension of conventional NFC connectivity and as such can enhance familiar NFC use cases, such as payment, access control, and rugged data transmission.

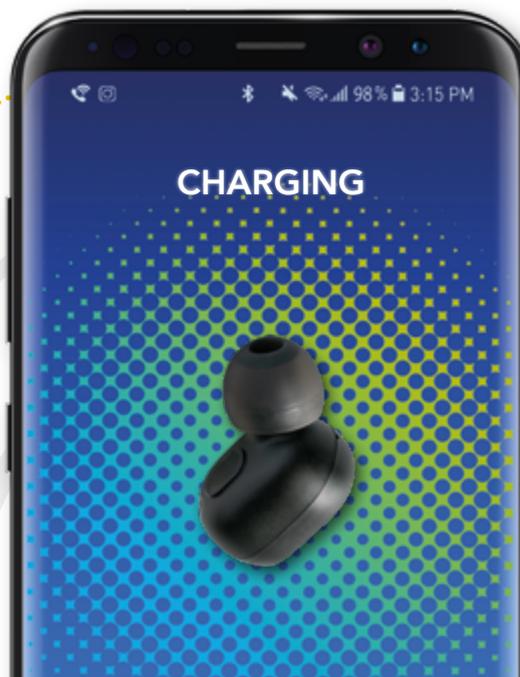
NEW DESIGN OPTIONS

Another bonus of NFC-driven wireless power: it's good for product developers and manufacturers, too, not just consumers. Developers can be more creative with their designs, since they're not hampered by the limitations of plugs or pogo pins. Products can be more streamlined, since they don't require sockets for plugging in, and can be entirely sealed, so they're resistant to water or dirt and can cope with intensive cleaning and sterilization cycles. Having a hermetically sealed electronic design opens up new options in exercise, personal care, medical, and industrial applications.



SIMPLIFIED PRODUCTION

From the manufacturer's standpoint, using NFC-driven wireless power to eliminate plugs and pogo pins lowers the bill of materials, simplifies manufacturing, increases reliability in the field, and lets the product use cheaper materials with lower tolerance ratings for voltage and ruggedness. There are fewer components to track and assemble, and fewer returns to manage or repairs to make if things go wrong in the field.



Using **NFC** and **Qi** for wireless charging might sound like a relatively new concept, but the technology behind it – inductive wireless charging – has been around for decades.

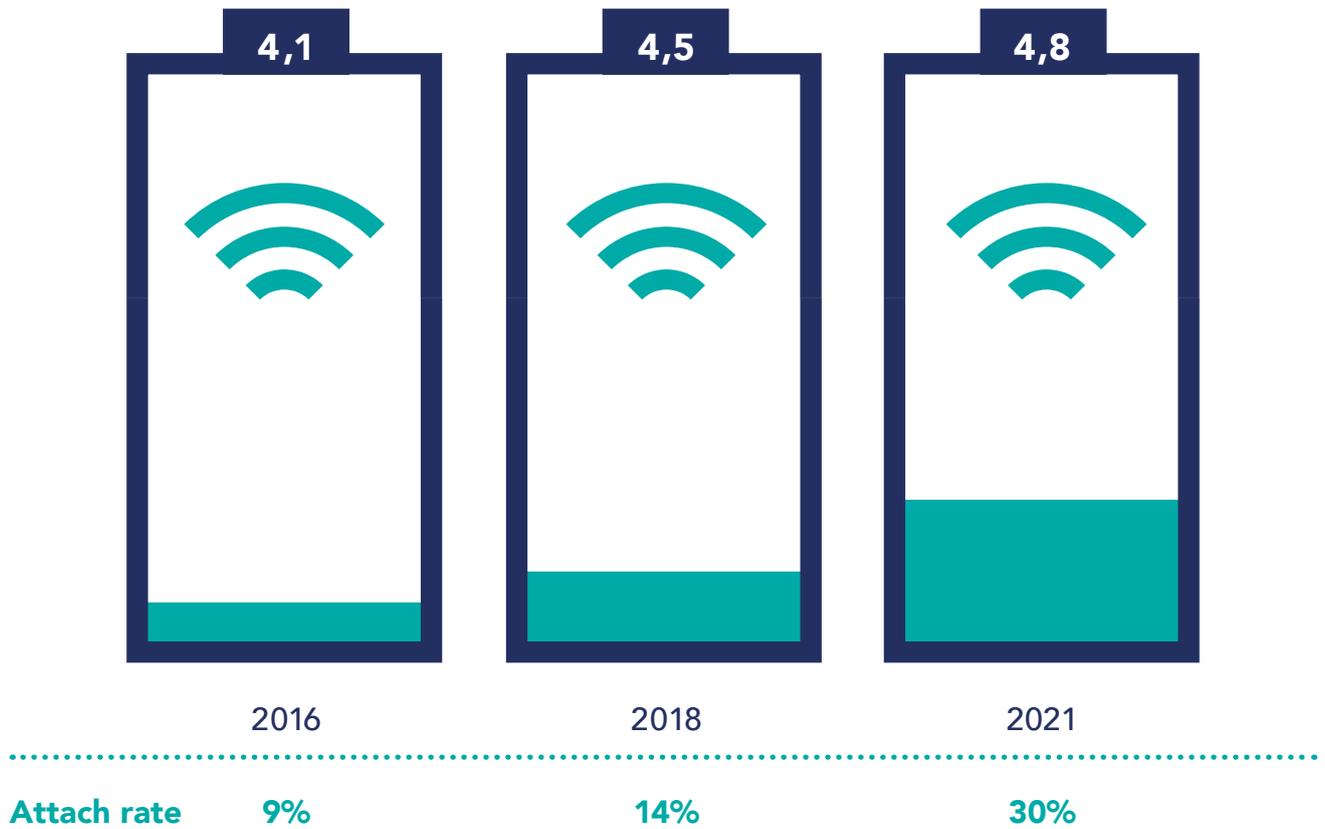
Consumer devices equipped with wireless charging, such as electric toothbrushes and other personal care items, have been on the market since the late 1980s. Today, wireless charging based on inductive technology is now a standard feature in smartphones and car dashboards.

In fact, wireless charging for mobile devices is expanding quickly and is supported by a growing infrastructure. Furniture-maker Ikea now offers a number of designs with wireless chargers built in, and cafés, bars, and other gathering places with charging-enabled tables are trending in Asia and elsewhere.

NFC AND Qi ARE CHARGING AHEAD

GLOBAL MARKET FOR WIRELESS CHARGING

World market wireless charging (Billion units)

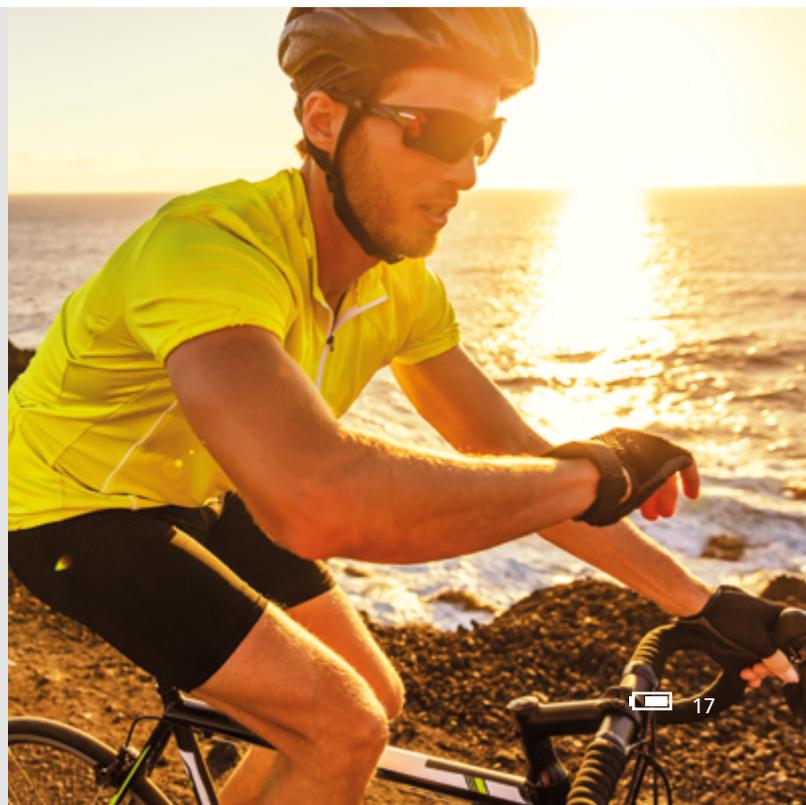


Total Available Market
 Service Available Market (includes Rx and Tx)

(Source: IHS Markit, Quarterly Wireless Power Tracker, July 2019)

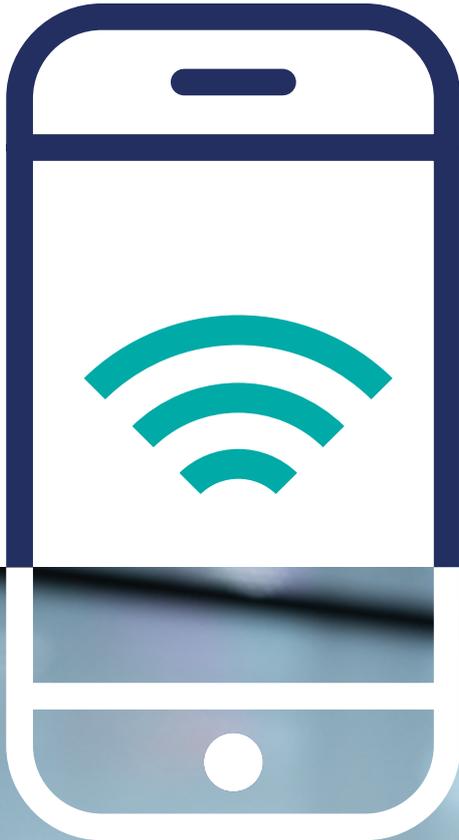
The total available market for **wireless charging** is estimated to grow 4,8 billion units in 2021.

The total available market for **small, battery-powered consumer and IoT devices** (suitable for NFC charging) will grow at an expected 22% CAGR worldwide between 2018 and 2021 and will represent 20% to 25% of the overall global total available market for wireless charging. **Attach rate for wireless charging** will grow from 9% or 0,4 billion units in 2016 to 30% or 1,4 billion units in 2021.



STANDARDIZATION AND INDUSTRY SUPPORT

A big reason why NFC and Qi are poised for such strong growth is that they both have strong industry backing and standards organizations guiding their development. Qi is governed by the Wireless Power Consortium (WPC), while NFC is overseen by the NFC Forum. Both groups are supported by market leaders and technology experts (including NXP) who contribute their know-how and industry influence to garner support for wireless charging applications and expand the market. Openness is another factor that encourages growth, with open IP policies, open and public standards, and independent global certifications schemes making it easier to ensure rapid growth and widespread adoption.



NFC Forum

- World's leading standards and advocacy association for Near Field
- Communication (NFC) founded 2004
- 140+ member organizations



Wireless Power Consortium

- Open, collaborative standards development group for Qi, Cordless
- Kitchen and Medium Power standard
- Founded 2008, 600+ member companies



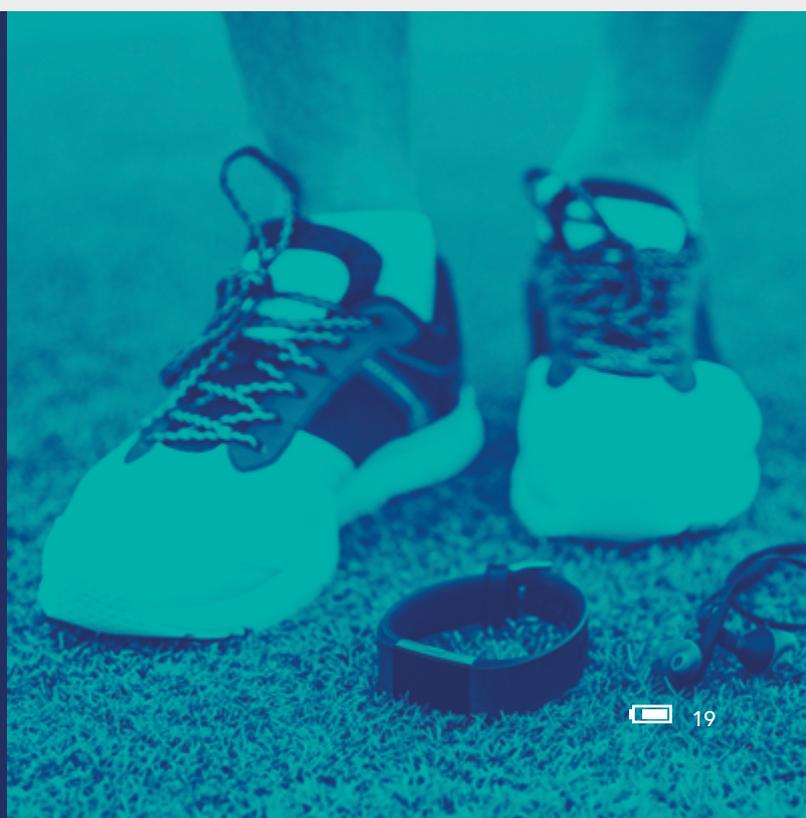


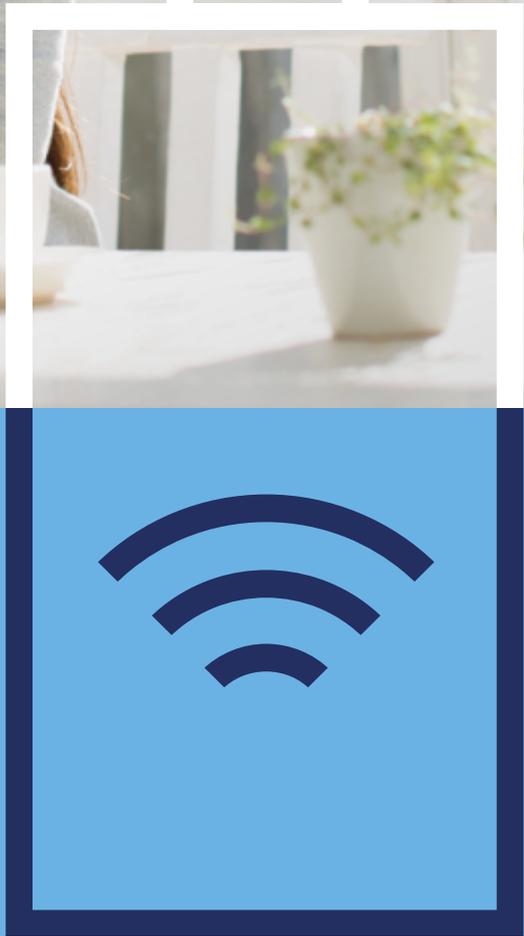
GLOBAL INTEROPERABILITY AND COMPLIANCE

By developing detailed technical specifications and rigorous test standards, the WPC and the NFC Forum ensure interoperability and create a solid, global infrastructure for wireless charging. This creates a strong foundation on which to build and makes it easier to create innovative products that consumers can be confident will work as expected. With a strong set of standards in place, anyone, anywhere can use wireless charging with confidence, knowing that charging will be as safe and convenient as promised.

SYSTEM-LEVEL SOLUTIONS

Working within the established ecosystem, which builds on the foundation of industry standards and certifiable interoperability, technology companies can build and deliver system-level solutions, which include everything from circuits and firmware to high-level software and built-for-purpose apps. That way, not only do OEMs have a quick, reliable, and cost-effective way to add wireless charging to their designs, they also gain the confidence that their product follows the system-level design rules necessary to make wireless charging a safe and reliable format that consumers can trust.





THE FUTURE OF CHARGING

Wireless charging lets us **rethink** the way we power our battery-driven devices. It's **simple, intuitive, and convenient**, and, like other wireless technologies, draws on a growing and widespread infrastructure.

Wireless charging is nothing short of a revolution. It eliminates an awkward and inconvenient task and replaces it with an action that is simple, uncomplicated, and convenient. Wireless charging makes battery recharges intuitive and efficient, and at the same time marks the arrival of sleeker, more streamlined, and more sustainable devices.



Since NFC and Qi can charge just about any electronic device that operates in the range between 0 and 2000W, and because these two technologies have strong support from the industry and standards bodies, we think wireless charging will soon become the norm.

As more products are available with wireless charging, our habits will change and **charging will become an intuitive action** that blends seamlessly with our natural movements and our daily routine:



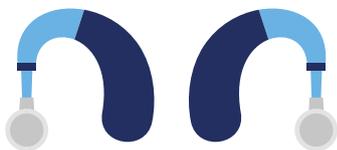
Your phone and key fob will charge when you set them on your car dashboard.



Your earbuds will charge when you take a break from listening and set them on your smartphone.



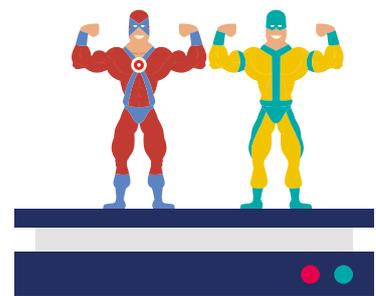
Your touch pen will charge as you press it against your tablet while your fitness tracker will charge overnight as it sits on your night stand.



Or your hermetically sealed hearing aids will charge overnight, without forcing you to fiddle with tiny plugs and ports.



Your laptop will charge during you're meeting as it sits on the conference table.



Your action figures will charge while sitting on your gaming console or set-top-box.

At NXP, we aim to make **wireless charging** as widely available as Wi-Fi is today. We are strong supporters of Qi and NFC, and are committed to seeing these two technologies thrive and the high and low ends of the power spectrum. It's our opinion that, by rethinking the way we power our battery-driven devices, we can finally stop worrying about how and when we'll get our next allotment of energy. And we can start thinking instead about how best to enjoy our mobile devices and the new experiences they enable.

