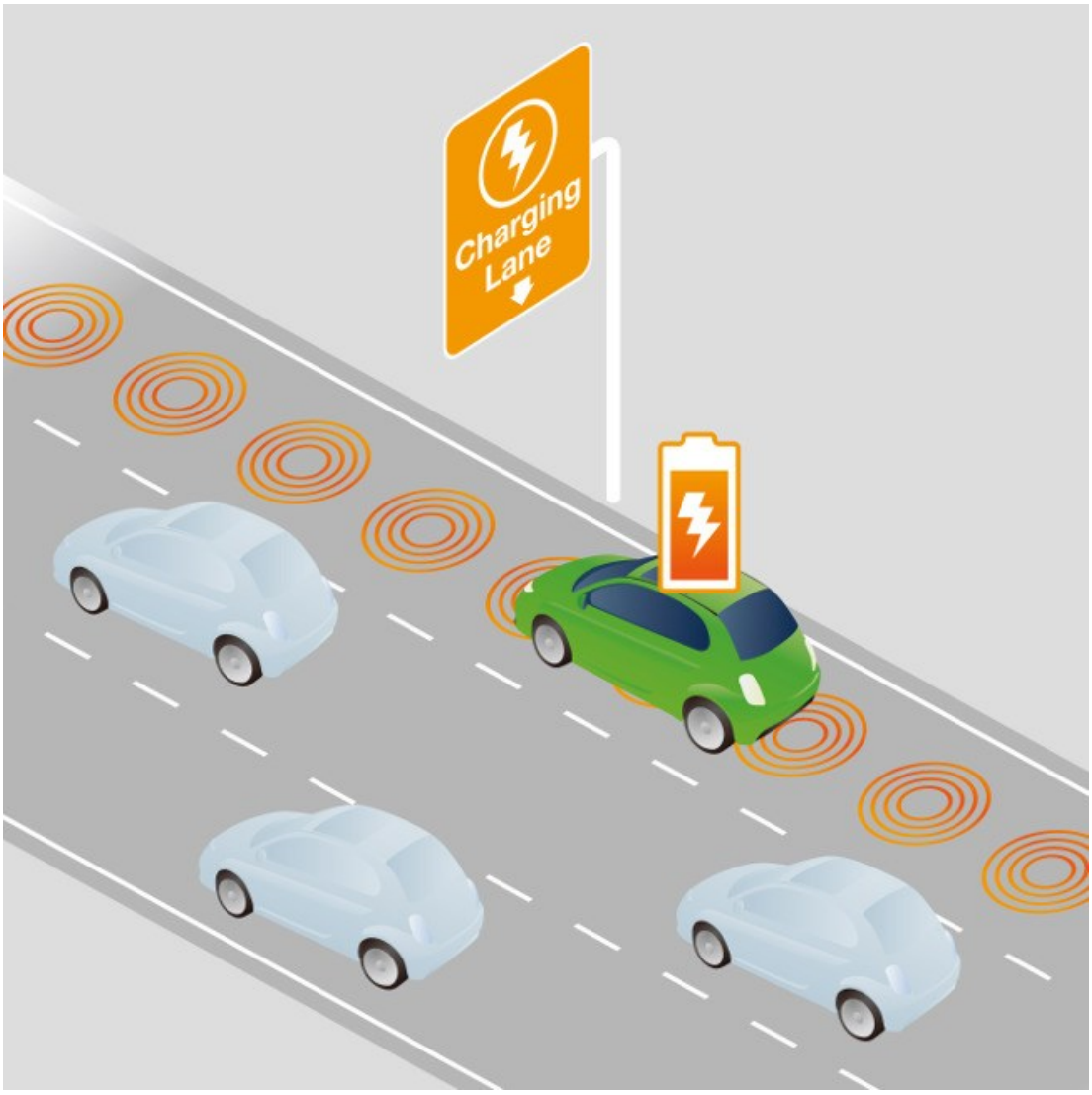
Docket #: S19-406

Efficient, Dynamic Wireless Power Transfer

Despite widespread adoption of stationary wireless charging, dynamic wireless power transfer suffers from a sensitivity to relative movement of the device with respect to the power source. Researchers in the Fan Group have boosted efficiency to 92% by using a switch-mode amplifier and appropriate feedback with a parity-time symmetric circuit scheme. Efficiency is independent of distance (within 6 feet) and orientation, and limited to losses of the transmit and receive coils. The new lab prototype transmits 10 watts over a distance of 2-3 feet in a few milliseconds – a fraction of the time needed for a car moving at 70 miles an hour to cross a four-foot charging zone - and can be scaled up to supply the 10-100 kilowatts needed for car charging, making the PT-symmetric scheme practical for robust, efficient, 'on-the-go' wireless power transfer.



(Image credit: The Fan Group)

Stage of Development – Prototype
Researchers in the Fan group have built and tested a lab prototype that wirelessly transmits 10 watts over a distance of 2-3 feet in a few milliseconds. Research is ongoing.

Applications

- Dynamic wireless power transfer
  - Electric vehicle charging while in use
  - Portable electronics charging while in use
  - Robotics charging while in use

Advantages

- High efficiency power transfer – 92%
- Robust with transfer distance variation
- **More convenient, more productive, reliable, automatic charging and direct wireless power** for: mobile phones, handheld devices, printers, displays, robots, cordless tools and instruments.
    - Charging on the go could **increase EV effective driving range and EV adoption**.
    - Handheld medical instruments, and diagnostic equipment charged on the go, **eliminates need for cables**, and stationary charging.
    - **Increased design flexibility and robustness for thinner, waterproof devices** - eliminates failure prone wiring, complex docking and battery replacement.

Publications

- Assawaworrarit, Sid, and Shanhui Fan. "Robust and efficient wireless power transfer using a switch-mode implementation of a nonlinear parity–time symmetric circuit." *Nature Electronics* 3, no. 5 (2020): 273-279. https://doi.org/10.1038/s41928-020-0399-7
- ANDREWS, EDMUND L.. "Stanford researchers one step closer toward enabling electric cars to recharge themselves wirelessly as they drive," Stanford News, 4 May 2020.
- "Shanhui Fan and Sid Assawaworrarit: Unplugged," Stanford Engineering News, 8 May 2020.

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