EVOLUTION OF WIRELESS CHARGING FOR LAPTOPS, POWER TOOLS AND THE IOT

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BUSINESS & TECHNICAL LEAD

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NXP
SECURE CONNECTIONS FOR A SMARTER WORLD
WIRELESS POWER COMING EVERYWHERE

2kW – 20kW
Electric Vehicles

200W – 2000W
Kitchen Appliances

30W – 200W
Laptops, Power Tools, Home Appliances

5 - 15W
Smart Phones

<1W
Hearing aids, wearables
INTEROPERABILITY DEMAND

Devices accessed on same place should work with same TX pad
• Office, hotel, home, airport, car, coffee, ...
• Interoperability is crucial for ease of use

30W – 200W  Laptops, Power Tools, Home Appliances
5 - 15W     Smart Phones
<1W        Hearing aids, wearables
BATTERY CHARGING VS. POWER SOURCE

Not just different power levels but also different applications
- Laptops, monitors – power supply (voltage source)
- Power tools, vacuum cleaners, drones – current supply (current source)

Common basis should be kept to allow interoperability – enable all applications

- Power supply
  - Constant voltage (USB-C/barrel equal)
  - Stable power/fast communication
  - Addresses dead/no battery scenario
  - PC0 (mobiles) interoperability required
  - Required by laptop power architecture

- Battery charging
  - Constant current
  - Power interruptions/slow communication
  - Needs to be connected to battery all time
  - No PC0 (mobiles) interoperability required
  - Suitable for power tools
HIGH CONSUMER DEMAND FOR LAPTOPS

Q: Which of the following devices would you expect wireless charging to be embedded in the future?

76% of consumers expect wireless charging in laptops

Source: WPC, Jan ‘17

N=2,000
WIRELESS POWER FOR PORTABLE COMPUTERS
CUTTING THE LAST CORD

Support 45/65/90W systems, plus Turbo
Covers entire range of power levels

Fits into the tightest industrial design:
<2mm in thickness, low component count

Cooling concerns eliminated:
Operates at >90% power transfer efficiency

Broad spatial freedom in all directions:
x-y plane, extended z-height

Great user experience:
Completely clean, cable free table
USER EXPERIENCE

• Same performance as wired power source
  - **No compromise** for wireless power

• Qi PC0 5-15W and ultra low power compatibility
  - **Same interface** for smart watch, phone and laptop

• Freedom of positioning
  - **No adjustment** to small area

• Works every time
  - **No waiting time** for dead battery recovery
WIRELESS POWER – NOT WIRELESS CHARGING

Voltage characteristic equal to USB-C PD and barrel connector **power source**

3.3V to power up system without battery involvement

Power source info

USB type-c

NTB barrel jack

DC/DC

RX control micro

WPRX

Control

DC voltage

NTB power management + battery
CHALLENGES

• Load transients
  – Stable DC voltage during **1A/1us** change

• Efficiency/temperature
  – Skin temperature must be under **48°C**

• EMC/EMI
  – **No interference** with other systems (touchpad, screen, Bluetooth, NFC, Wi-Fi, …)

• Authentication
  – Proven operation is critical for, all **Qi compatible** devices must be **certified**
CHALLENGES

• Always up-to date SW
  – Possibility to update TXs in the field to last spec version

• Freedom of placement
  – Users do not want to precisely place RX on one spot

• Interoperability
  – 3 different pads on the table for 3 different devices don’t make any sense

• FOD
  – Heating of foreign objects or any damage to other devices must be prevented
# LAPTOP WIRELESS POWER TECHNICAL DETAILS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Power</td>
<td>45-90W</td>
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<tr>
<td>TX – RX gap (z)</td>
<td>4 – 20mm</td>
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<tr>
<td>Free positioning (x/y)</td>
<td>30mm in each direction (single-coil), unlimited (multi-coil)</td>
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<tr>
<td>Robust communication</td>
<td>Bi-direction <strong>NFC</strong> (power control, card protection, authentication, FW update)</td>
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<tr>
<td>EMC/EMI</td>
<td>No interference with touchpad, screen, Bluetooth, NFC, Wi-Fi, …</td>
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<tr>
<td>High efficiency</td>
<td>92% – 82% (depends on displacement)</td>
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<tr>
<td>Working frequency</td>
<td>100 – 145kHz</td>
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<tr>
<td>Interoperability</td>
<td>PC0 + NFC wireless power support</td>
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[Diagram showing wireless power transfer between TX and RX coils]
WIRELESS POWER & NFC

Robust communication link between TX and RX
NFC is running simultaneously with Wireless Power
Tightly coupled system – same principle as wireless power – no interference with another RX

Power Control
- Fast feedback loop from RX output voltage/current to TX PID regulator during power transfer

Safety
- Detection and protection of payment cards, passports, IDs, etc

FW Update
- Possibility to updated FW in TX unit through RX device

Authentication
- Fast authentication to ensure safe and seamless interoperability
WIRELESS POWER THROUGH NFC

<1W Hearing aids, wearables

- NFC RF field is directly charging a small battery
- Proven operation of charging a fitness tracker battery of 150mAh conveniently within an hour at a minimum cost
- NFC transmitter in every Qi TX will enable broader interoperability
NXP WIRELESS POWER SOLUTION

Qi Certification
Software
NFC
Controller
Transmitter & Receiver Hardware