Different types of vehicle charging
Stationary charging - conducted

mode 1: AC charging from a regular power socket

mode 2: AC charging with a mobile charging station

mode 3: AC charging with a stationary charging point

mode 4: DC charging with a DC charging station
Conducted charging aspects – AC

mode 2 and 3 uses pulsed communication – CP (Control Pilot)
1 kHz pulses
May couple to AC wires – impact on conducted emission
Signal interface has no legal EMC requirement
Conducted charging aspects – DC and different markets

Asia (ChaDeMo):
- uses CAN communication
- Separate balanced wires
- Signal interface has no legal EMC requirement

Europe and US (CCS):
- uses Power Line Communication (PLC)
- Superimposed on CP
- Signal bandwidth 1.8 – 30 MHz
- Signal return in PE
- Very efficient crosstalk in cable
- Signal interface has no legal EMC requirement
AC charging example (Mode 3)

Mode 3 charging posts in parking lot
Can be several boxes
Parking lots
Parking houses
Private houses
All vehicles comply to the exact same emission requirement as all your equipment in your house
DC charging example (Mode 4)

Shell and BYD cooperation

258 DC charging points

Note the airplane takeoff to the right...
Stationary charging - wireless

https://www.media.volvocars.com/global/en-gb/media/videos/295948/wireless-charging-original

- Resonant charging around 85 kHz
- Guided manual alignment of coils
- EMC requirements: vague situation - CISPR 11 G1 class B?
- Signaling during charging = radio?  
  Signaling via separate WiFi = non-radio?
On road charging

<table>
<thead>
<tr>
<th>Overhead</th>
<th>Sideways</th>
<th>From below</th>
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<tbody>
<tr>
<td><img src="image1" alt="Conductive" /></td>
<td><img src="image2" alt="Conductive" /></td>
<td><img src="image3" alt="Conductive" /></td>
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<td><img src="image4" alt="Inductive" /></td>
<td><img src="image5" alt="Inductive" /></td>
<td><img src="image6" alt="Inductive" /></td>
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</tbody>
</table>

- Charging moving objects
- Minimizing batteries, replaced by infrastructure
- Not supported by vehicle type approvals
- = Railway on rubber wheels?
Not included: fuel cell technology

In essence an electric vehicle "charged" by filling with hydrogen.
V O L V O