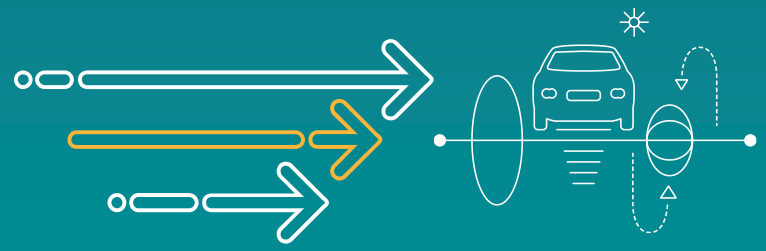
Dr. Nicholas Keeling
Qualcomm
28/01/16

Current status and outlook of stationary and dynamic wireless electric vehicle charging

QUALCOMM HALO™



Societal Trends Advancing The EV Market

Global urbanisation

70% of world's population will live in cities by 2050

(World Health Organization 2014)

Infrastructure strain

Total global vehicles increasing from 1.1bn today to 2.5bn by 2050

(OECD Report 2012)

Air pollution

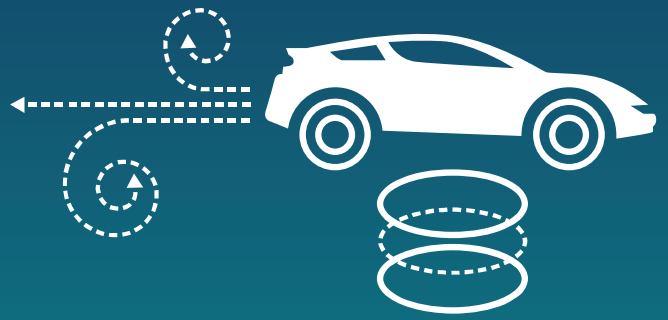
Legislation and fines for pollution

(Environmental Protection Agency – European Commissions)

Health costs

Urban outdoor air pollution is estimated to cause 1.3 million deaths worldwide per year

(World Health Organization)



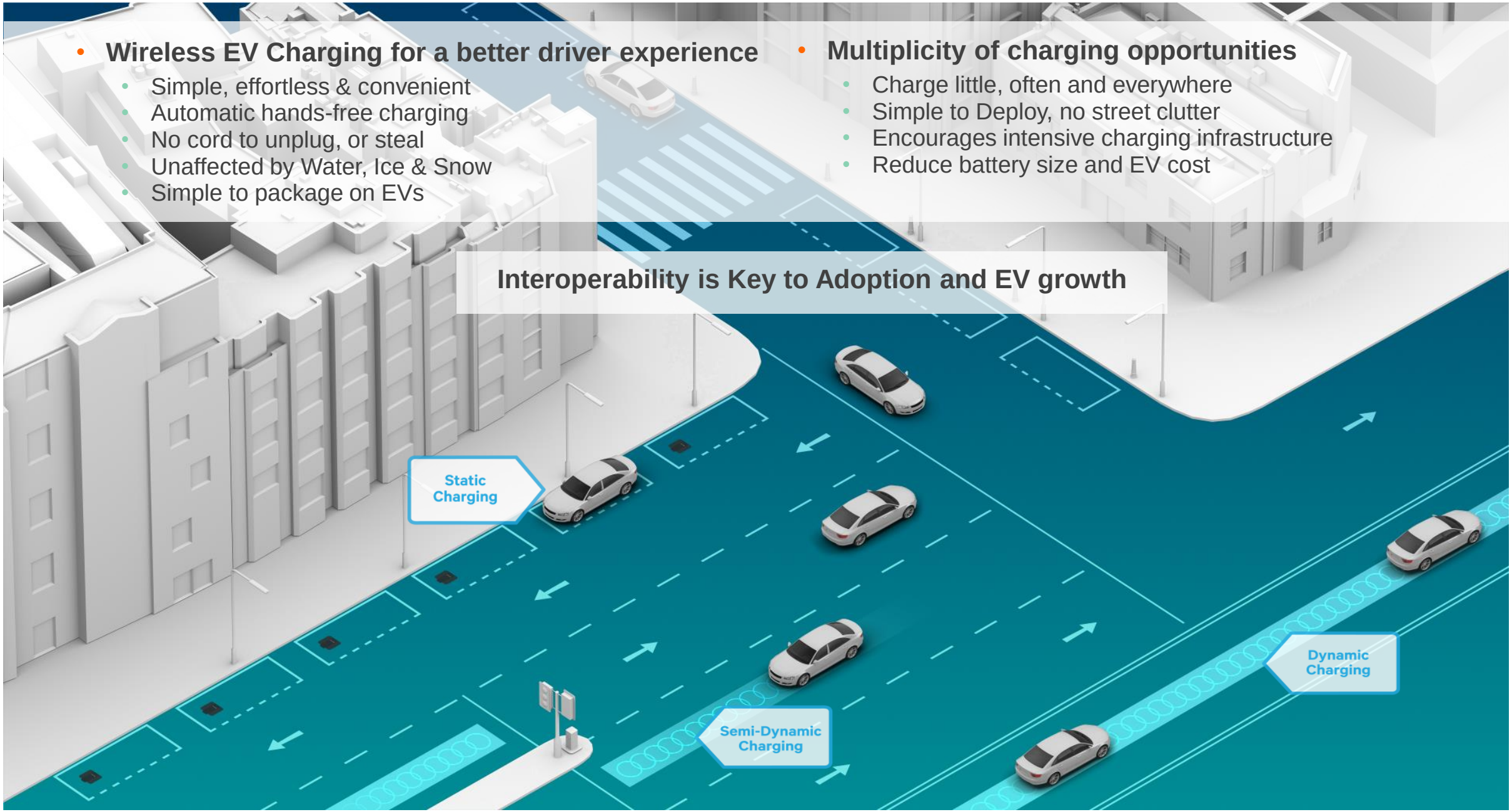
EV Challenges

- Lack of Standards
- Limited Range
- Time to Charge
- Ease of Charging

- **Wireless EV Charging for a better driver experience**
  - Simple, effortless & convenient
  - Automatic hands-free charging
  - No cord to unplug, or steal
  - Unaffected by Water, Ice & Snow
  - Simple to package on EVs

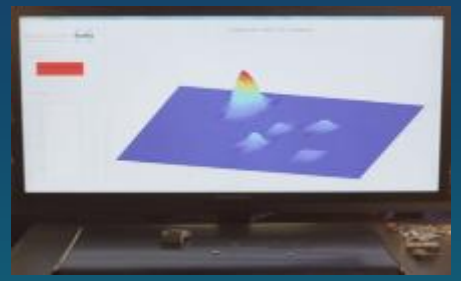
- **Multiplicity of charging opportunities**
  - Charge little, often and everywhere
  - Simple to Deploy, no street clutter
  - Encourages intensive charging infrastructure
  - Reduce battery size and EV cost

Interoperability is Key to Adoption and EV growth

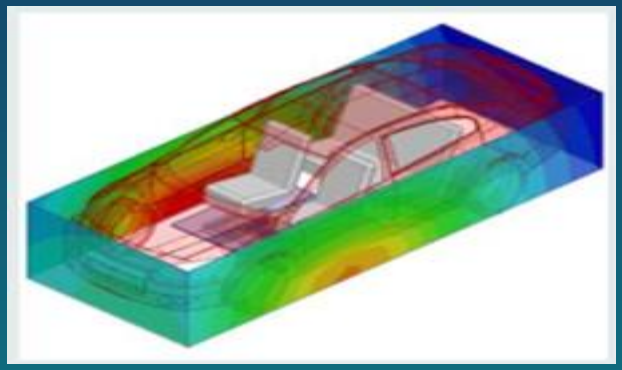


WEVC: Required Compentencies

IPT Magnetics&
Power Electronics

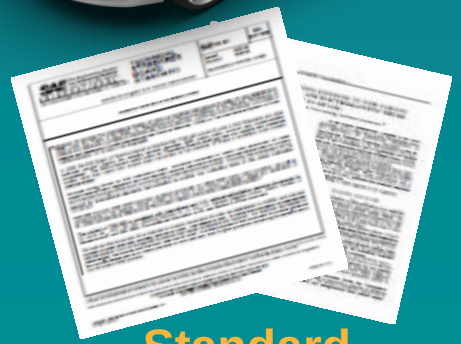


Auxiliary: FOD, LOP,
Positioning



Regulatory Compliance

Application -
System integration



Standard

Communication

Static WEVC Standards Overview

ISO (TC22/SC21)
International Standardization Organization
ISO 19363

Vehicle Side

Infrastructure Side

IEC (TC69)
International Electrotechnical Commission
IEC 61980

→ Qualcomm are involved in ISO and IEC to cover both the infrastructure and the vehicle standardization

SAE
Society of Automotive Engineers
SAE J2954

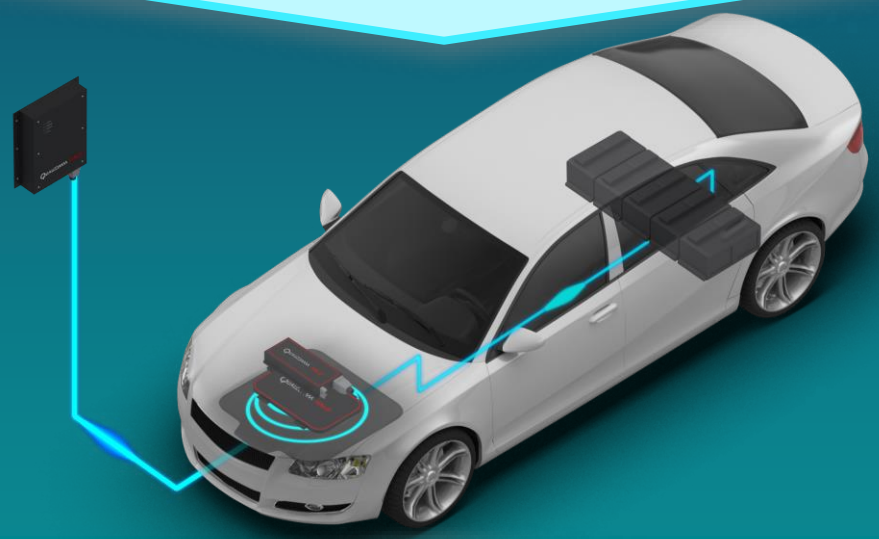
Standardization Areas and Constraints

INTEROPERABILTY REQUIREMENTS–

- Common Operating Frequency
- Magnetic interoperability between vehicle assembly (VA) and ground assembly (GA)
- Vehicle to charger communications
- Default alignment mechanism
- Agreement on VA and GA positioning in parking bay

SAFETY CONSTRAINTS – Thermal and RF

- Foreign Object Detection
- Living Object Protection
- Circuit protection layers
- System control



PERFORMANCE

- Power Levels (3.7, 7.4, 22kW)
- Efficiency
- Air gap (absolute and range) [Z1, Z2, Z3}
- Alignment tolerance
- Stationary, Semi-dynamic, Dynamic

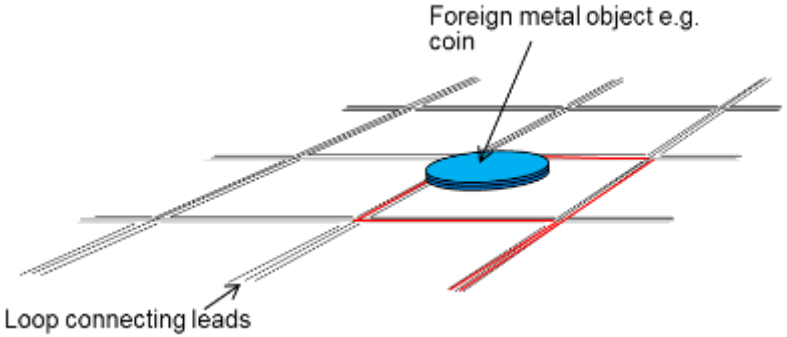
COEXISTENCE – RF and EMC regulations

- Vehicle Systems
- Implantable Medical Devices
- Communication Services

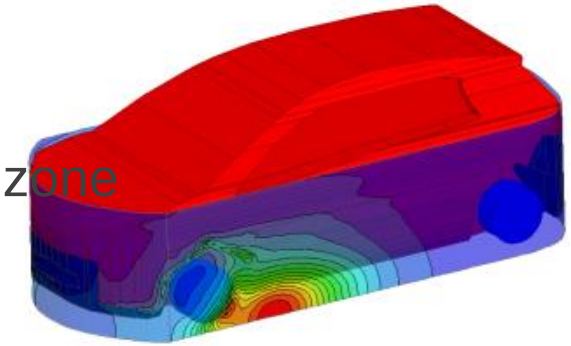
Safety

Protection from foreign object heating and emissions

- Foreign Object Detection
  - Metallic objects heat in the HF field
  - Loop array used to detect objects



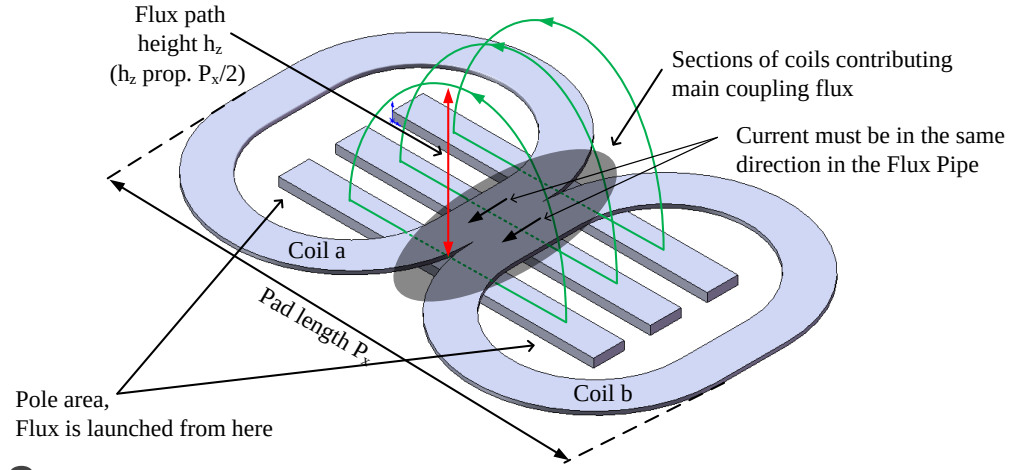
- Living Object Protection
  - Radar based monitoring
  - Virtual fence around high emission zone



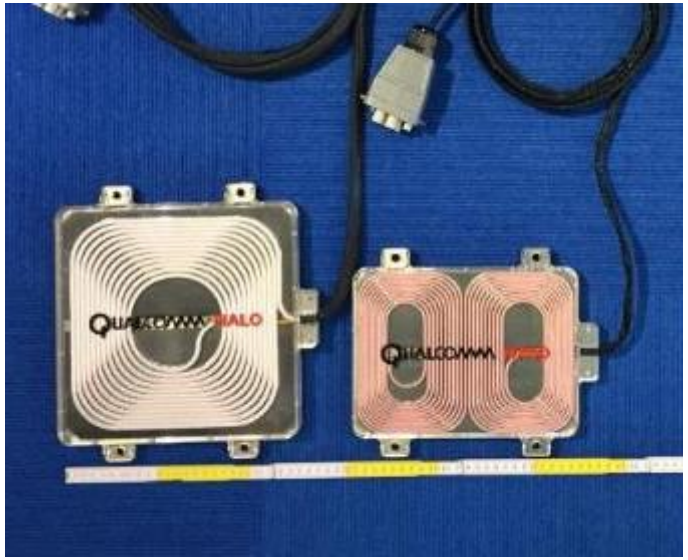
3.7 & 7.4 kW Magnetic Pad Options

About 40% reduction in DD pad size for same performance as Circular pad

- Interoperability must be considered

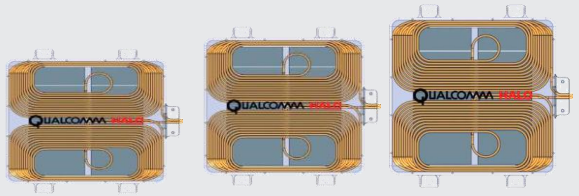
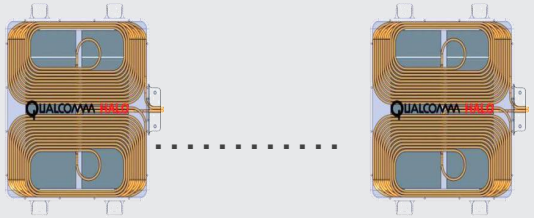


3.7 kW: 250mm x 190mm



7.4 kW: 340mm x 270mm

Evolution From Stationary To Semi and Dynamic

	Stationary (*)	Semi & Dynamic (**)
Frequency	85 kHz	85 kHz
Power Classes	**3.7 / 7.4 / 22 kW**	**10/ 20 / 40 / 200 kW**
Offset Tolerance (x/y)	±75 / ±100 mm	Not relevant / ±200 mm
Magnetics (vehicle side)		

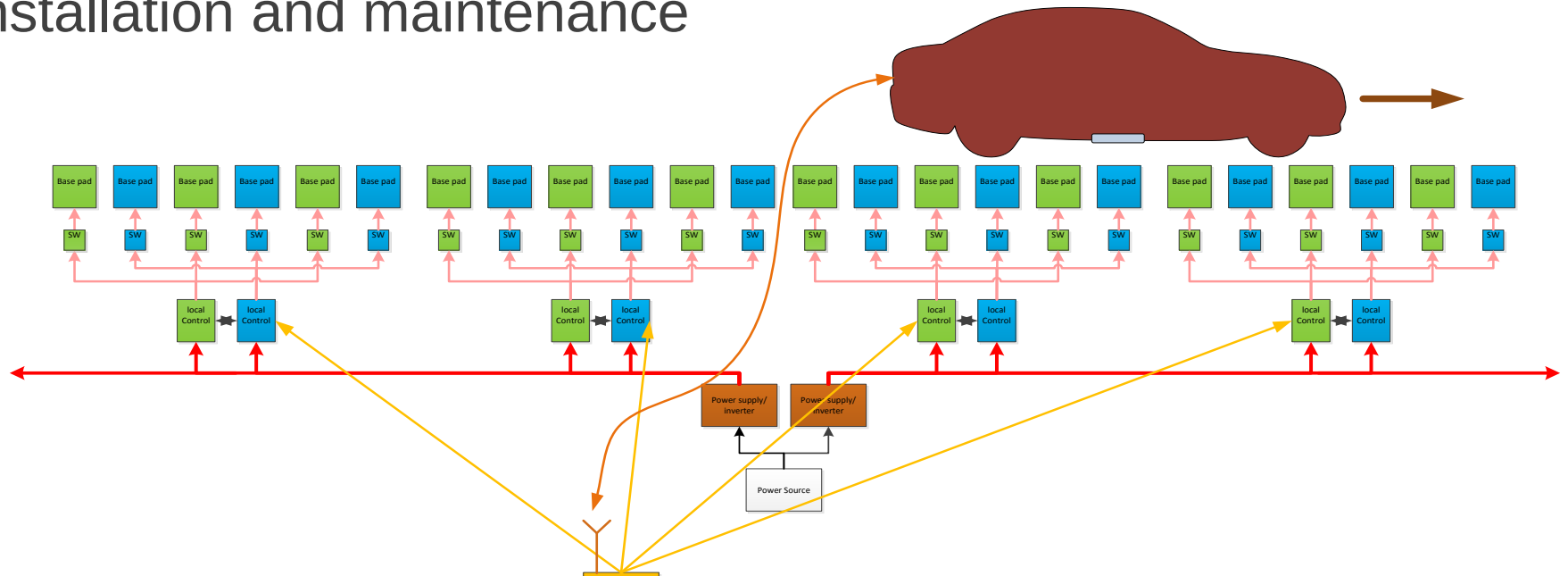
(*): Based on worldwide standardization

(**): Proposal for FABRIC project (currently, there are no standards specifying requirements for dynamic charging)

Dynamic WEVC Charging

Challenges

- Compatibility with static charging standards
- Power distribution network topology
- Cost distribution between vehicle and base
- In road installation and maintenance



FIA Formula·e CHAMPIONSHIP

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Driving adoption
of new technologies for EVs:
Qualcomm HALO WEVC

Enhancing
the connected fan experience

Thank you

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