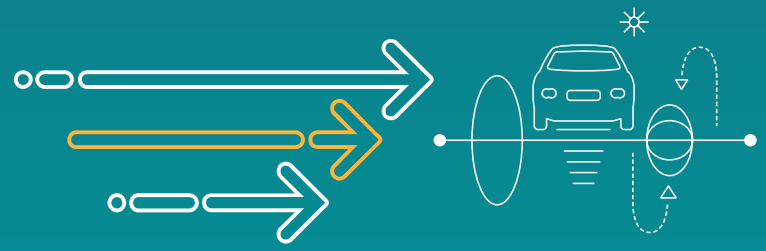
John Boodhansingh, Sr Dir Product Management
Qualcomm Incorporated
May 16, 2016

The Future of Urban Mobility is Connected, Electric & Wireless

QUALCOMM HALO™



TECHNOLOGY BLOCKS

SCALE

SYSTEM EXPERTISE

COLLABORATION

GRAPHICS

SCAL
E

CLOU
D

MOBILITY

THE CONNECTED CAR OF THE FUTURE

MOBILE TECHNOLOGY

APPLICATIONS

AUTOMOTIVE INDUSTRY

INNOVATION

SILICON INVESTMENTS

EXPERIENCES

SYSTEM

CONNECTIVITY

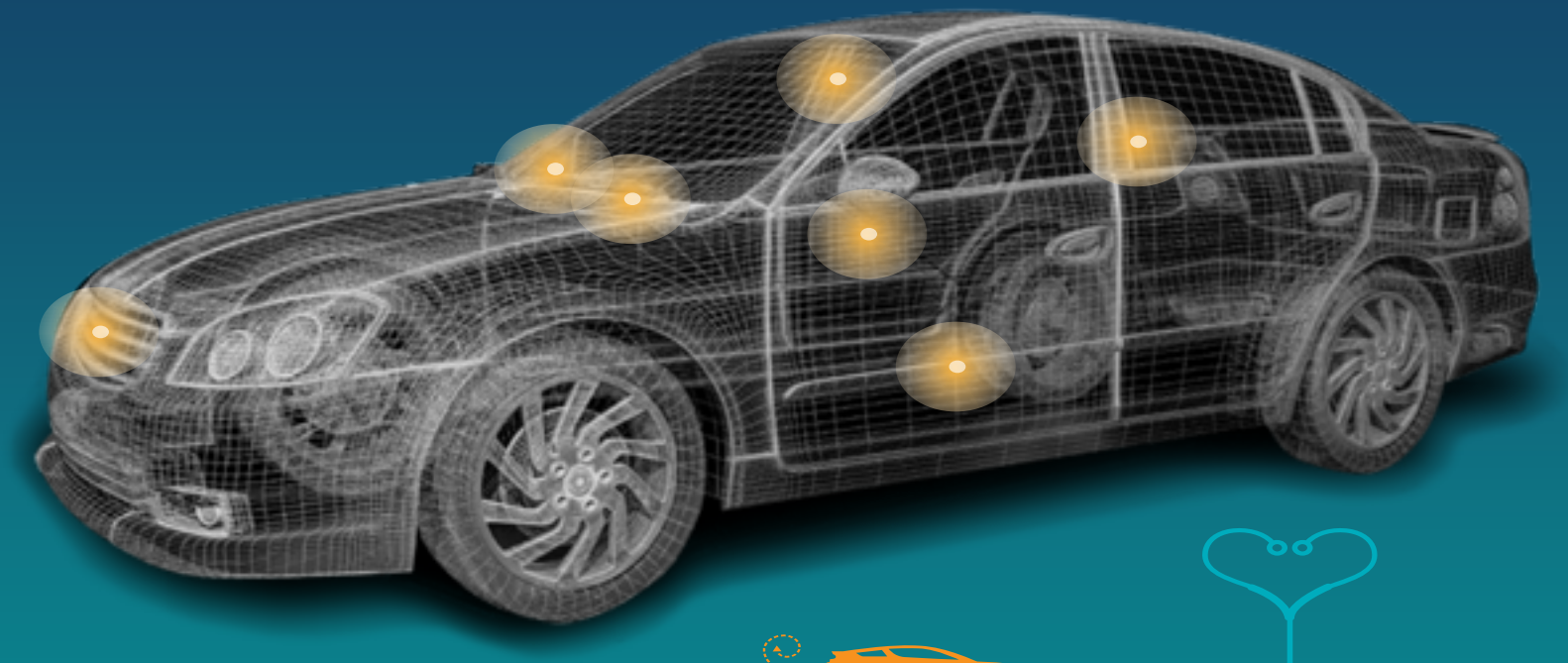
INVESTMENT

IMAGE PROCESSING

INTEGRATION

Multiple Technologies Intersect Automotive

Safer – Cleaner – Connected Mobility



Entertainment

Gesture

Location

Safety and Security

Wireless Charging

Health Monitoring

Augmented Reality

Peer to Peer

Cloud content

ADAS

Overview of Societal Trends

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 Commission)

Health costs

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

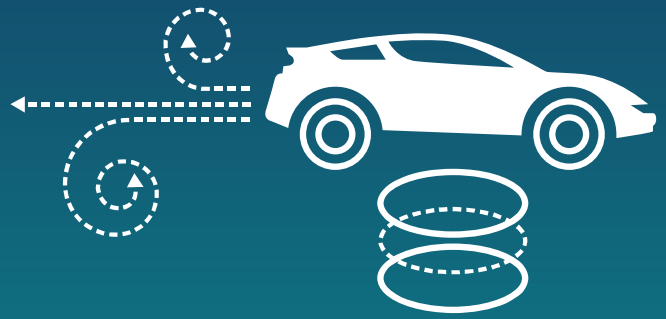
(World Health Organization)

Air pollution costs Europe £1.5tn per annum in early deaths and disease, according to The World Health Organisation!

Costs of polluted, dirty air are equivalent to one tenth of Europe's GDP

Germany, UK and Italy among the hardest hit economically

EVs - a Solution with Barriers to Mass Adoption



Benefits

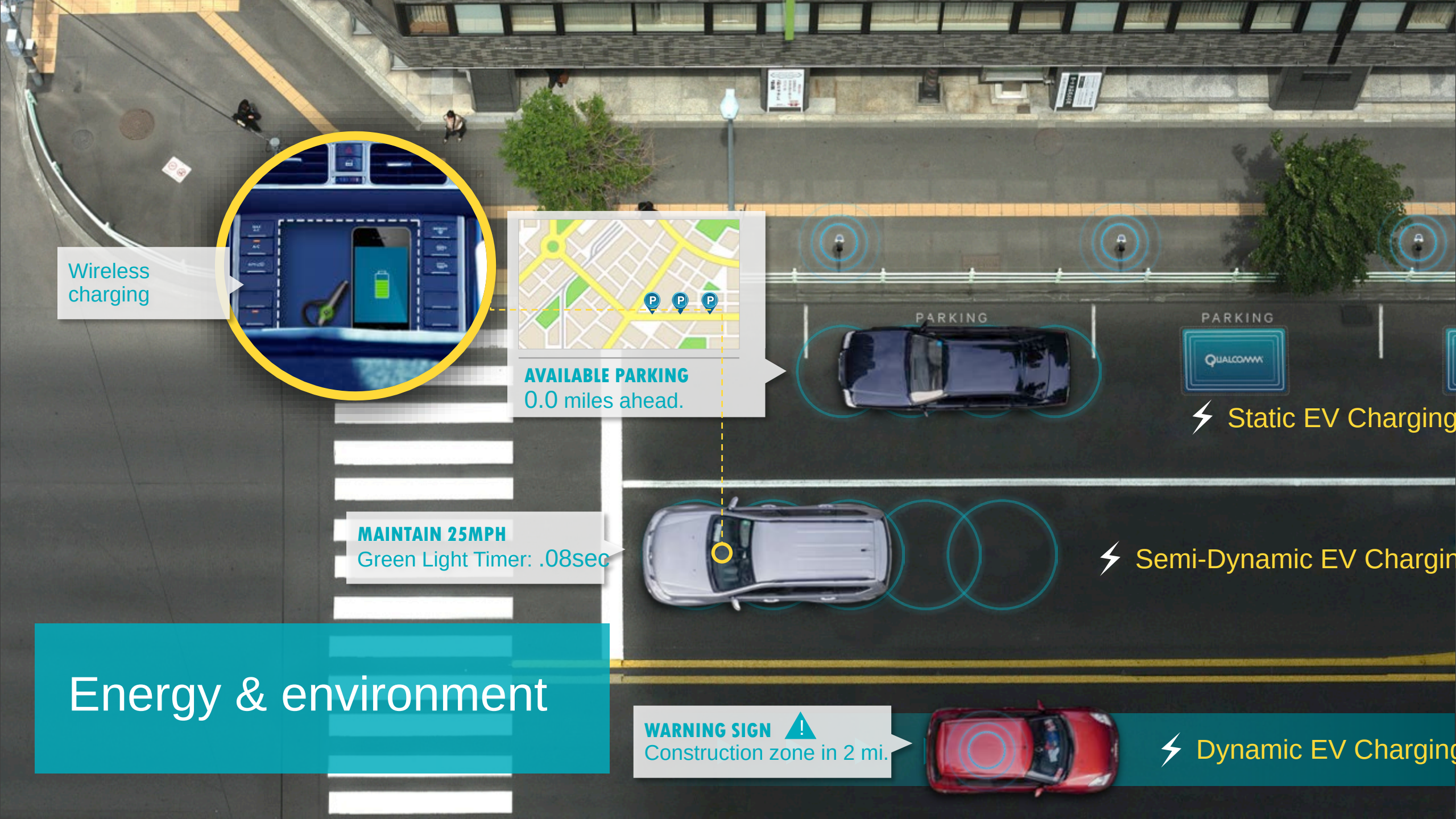
- Better energy economy
- Non-polluting
- Less noise
- Clean Streets

EV Challenges

- Cost
- Limited Range
- Time to Charge
- Ease of Charging

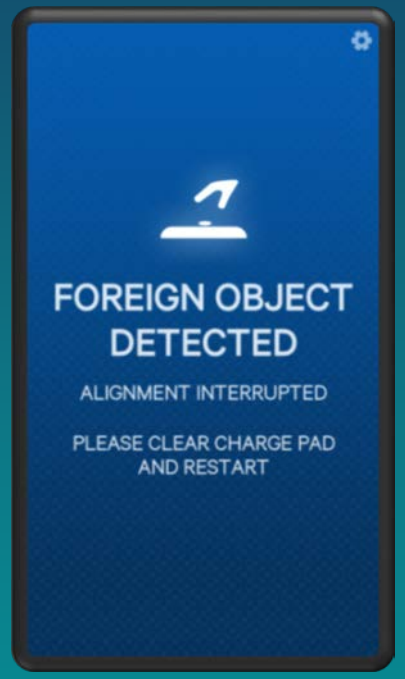
Infra Challenges

- Infrastructure Lag
- Charging Posts
- Trailing Cables
- Vandalism


Wireless charging
AVAILABLE PARKING
0.0 miles ahead.
PARKING
PARKING
QUALCOMM
Static EV Charging
MAINTAIN 25MPH
Green Light Timer: .08sec
Semi-Dynamic EV Chargin
WARNING SIGN
Construction zone in 2 mi.
Dynamic EV Charging
Energy & environment

Standards, Safety & Compliance

Regulations & Requirements



- Qualcomm Halo™ includes Foreign Object Detection and Living Object Protection
- Notification to driver when charging interrupted
- Agreed 81.38-90.00 kHz as operating frequency
- DD and circular magnetics options

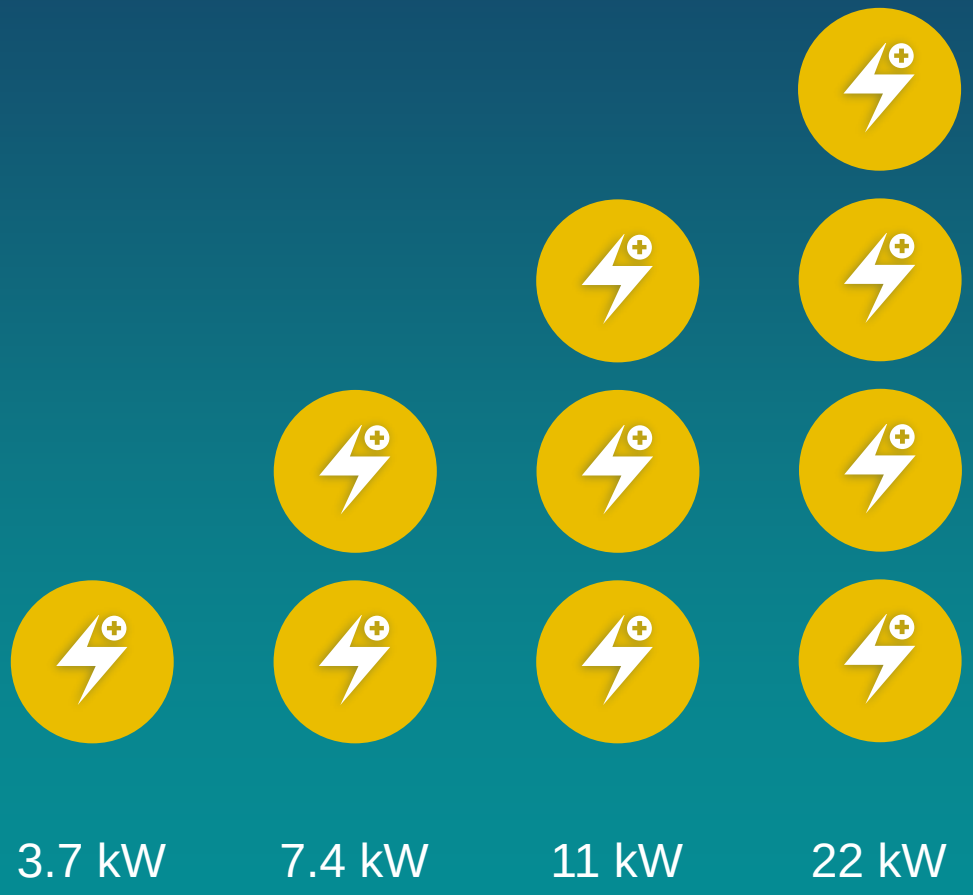
Positioning

Improved Parking Experience

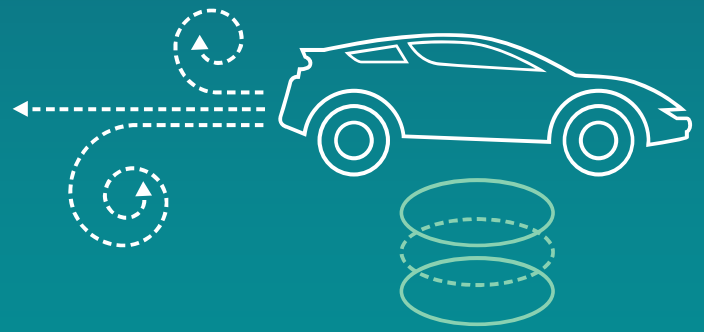
- Qualcomm Halo™ includes Foreign Object Detection and Living Object Protection
- Range enables seamless transition from visual of base pad to the vehicle's MMI
- Accuracy allows reduced tolerance and smaller vehicle pads
- Feedback to driver

Flexibility & Extensibility

Power Options and Fast Charging

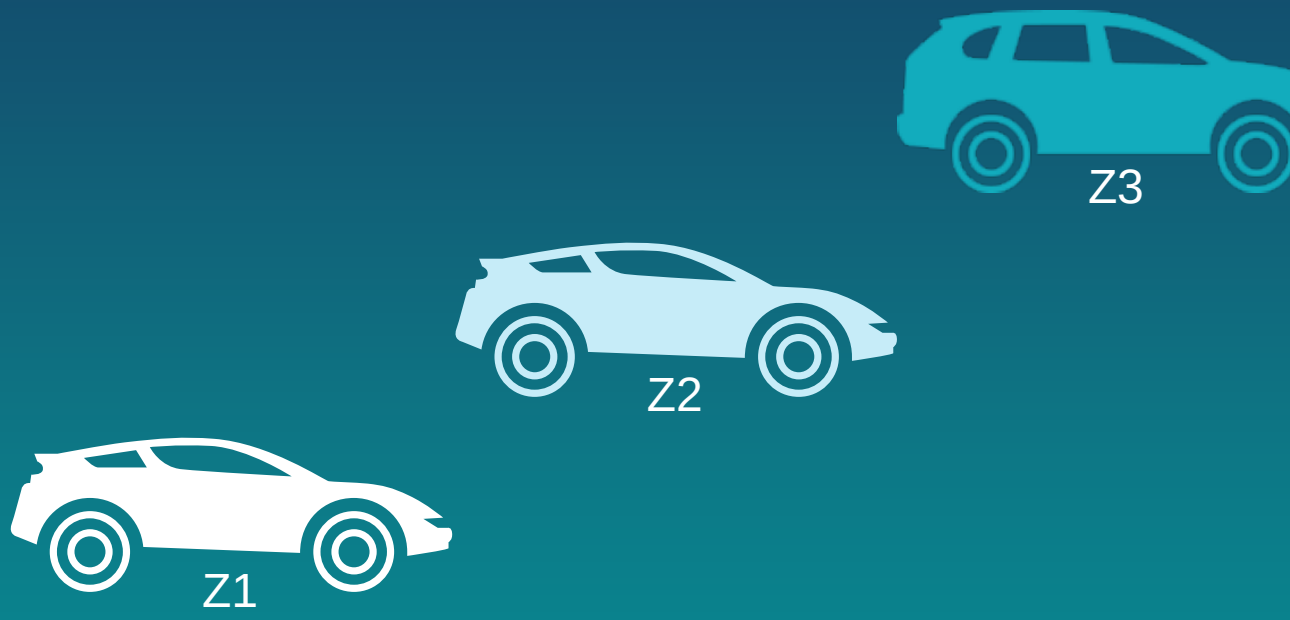


- First decision: how much power?
  - 3.7 kW / 7.4 kW / 11kW / 22 kW
- Like fast Broadband – drivers want faster charging at higher power levels
- Qualcomm Halo™ = higher power = more driving range per hour of charge



Vehicles Sizes & Base Pad Installations

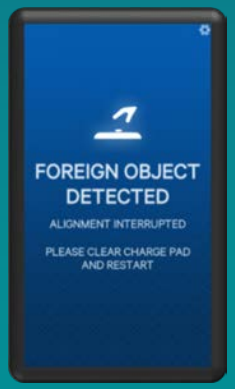
DD Magnetics



- Varying vehicle ground clearances across fleets
- Multiple charging location scenarios
- DD magnetics enables
  - Z1, Z2, Z3 vehicles
  - Surface, flush & buried base pad options
- Qualcomm Halo™ = more flexibility

Interoperability

Complex Technology in Harmony



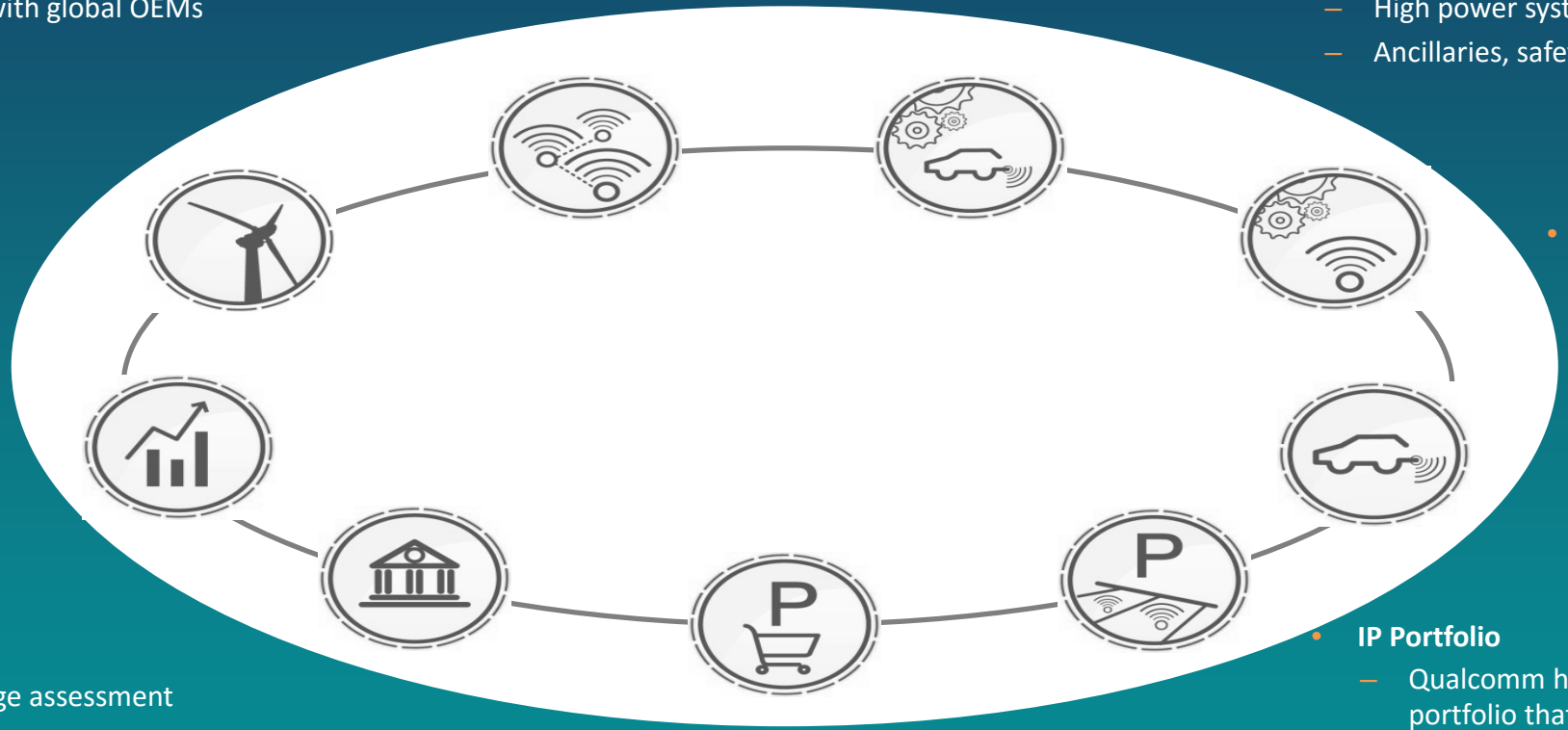
- Qualcomm Halo™ = complete solution
- 3.7 kW – 22 kW
- Z1 – Z3
- Surface, buried, flush base pads
- Positioning
- FOD, LOP

360° - WEVC Market Development

- **Legacy in Automotive**
  - 25 years of automotive innovation and partnership
  - Delivering innovative future-proof solutions
  - Delivering advanced engineering WEVC projects in partnership with global OEMs

- **25 Years' WEVC R&D and Engineering Collaboration with University of Auckland**
  - World leadership in wireless power for EV and industrial applications
  - World leaders in magnetic design solutions
  - Excellence and novelty in electronics and power electronics

- **Unrivalled R&D and Engineering Teams**
  - Three engineering centers (Munich, New Zealand and Switzerland)
  - Advanced magnetics design
  - Power electronics design, test and prototype
  - Dynamic and Semi-dynamic R&D
  - High power system design & prototyping
  - Ancillaries, safety systems and co-existence



- **Standards**
  - Active involvement developing & drafting of standards in SAE, CISPR, ISO, IEC, *et al*

- **Technology Transfer**
  - License partners gain deep understanding of Qualcomm Halo technology enabling future designs of bespoke WEVC systems
  - Familiarize with specific Qualcomm Halo WEVC implementations

- **Regulatory**
  - In-house expertise
  - Test and H-field leakage assessment
  - Simulation methodologies
  - Safety systems including living object protection and foreign object detection

- **Technology Pipeline**
  - Advanced technology roadmap for core system and ancillaries
  - Focus on cost and package optimisation; higher power; interoperability and co-existence
  - Dynamic and semi-dynamic systems
  - Prototypes systems and reference designs

- **IP Portfolio**
  - Qualcomm has a broad and deep WEVC patent portfolio that applies to various solutions that address real world technical issues
  - Broad spectrum of technologies covered by Qualcomm Halo patents includes solutions to problems related to magnetics, coupling factor, coupling factor variability, system operation, FOD, LOP, positioning, communications and others


RENAULT
QUALCOMM
MICHELIN
formula e


DHL
MICHELIN


QUALCOMM
SAFETY CAR
QUALCOMM


QUALCOMM
SAFETY
DHL

Thank you

Follow us on:

For more information on Qualcomm, visit us at:
www.qualcomm.com & www.qualcommhalo.com