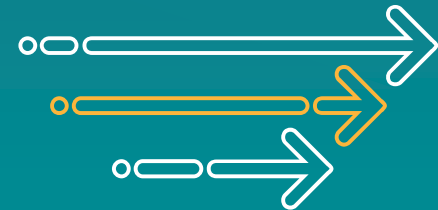


Dr. Chris Borroni-Bird,
VP, Strategic Development, Qualcomm Technologies Incorporated

Enabling Connected and Electric Vehicles



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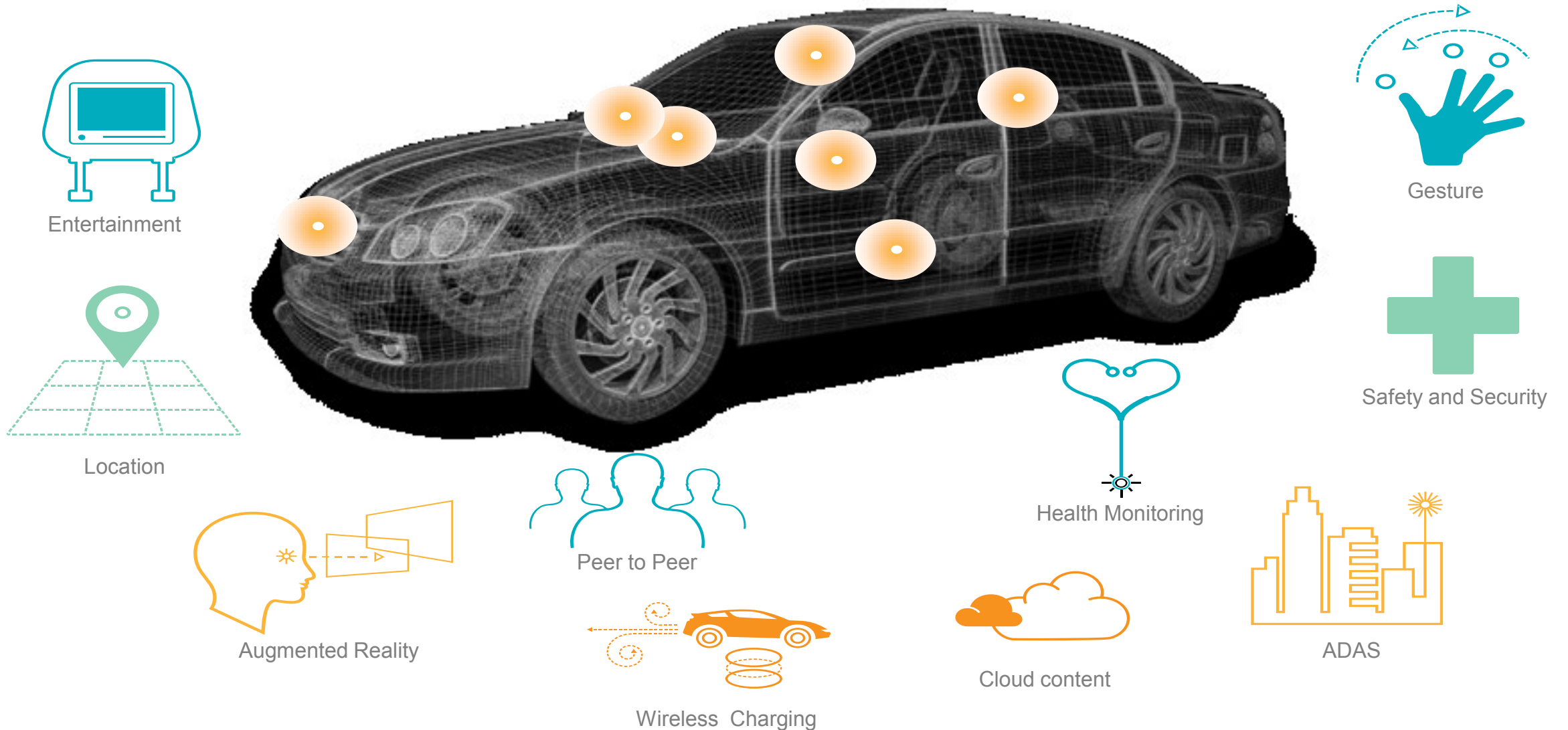
WEVC

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Multiple technologies intersect automotive



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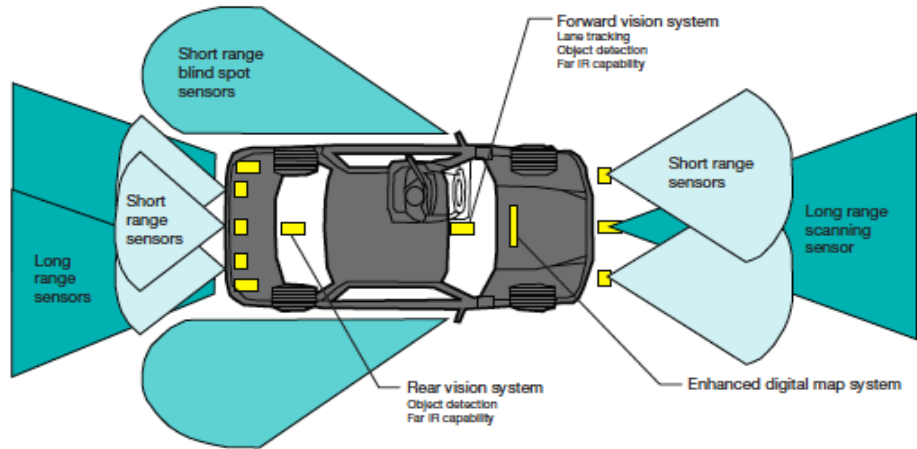
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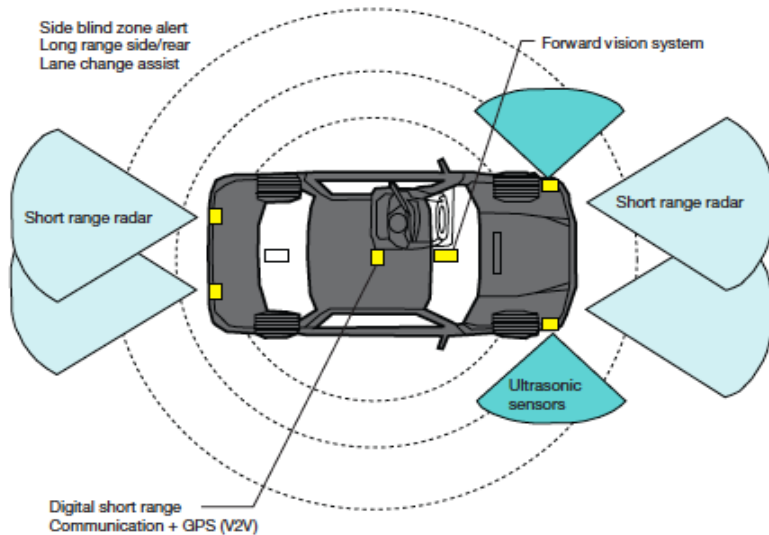
Fusion Of Sensing And Communications



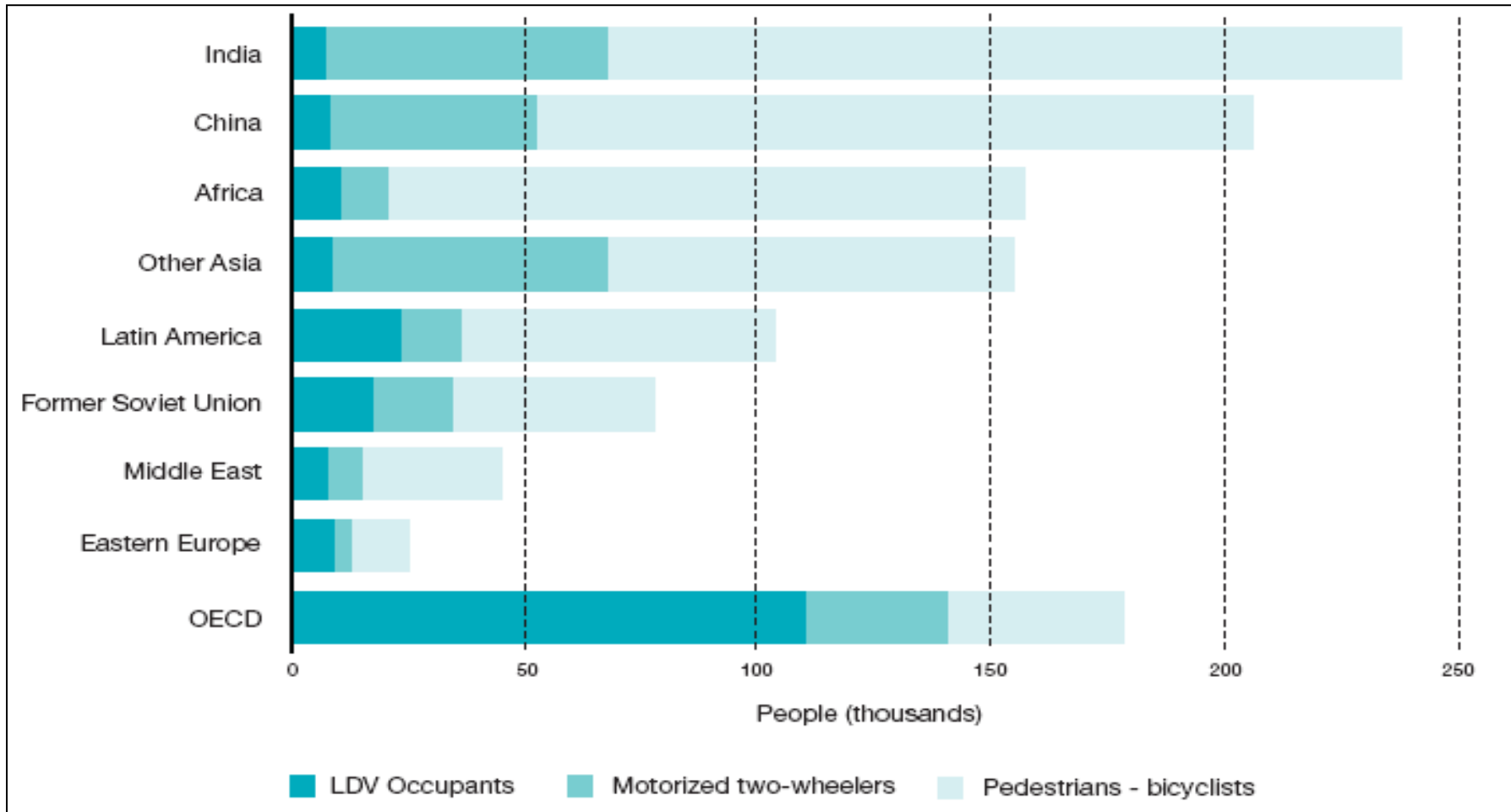
■ Limitations of Sensor-only based solution

- Degraded under certain environmental conditions
- Limited in non-line-of-sight use cases
- May not be cost-effective for mass market adoption
- Difficult to retrofit existing fleet

■ V2V may address some of these limitations, using DSRC (Dedicated Short Range Communications)



Road Safety



2004

Rank	Disease or Injury
1	Ischaemic heart disease
2	Cerebrovascular disease
3	Lower respiratory infections
4	Chronic obstructive pulmonary disease
5	Diarrhoeal diseases
6	HIV/AIDS
7	Tuberculosis
8	Trachea, bronchus, lung cancers
9	Road traffic injuries
10	Prematurity & low-birth weight

2030

Rank	Disease or Injury
1	Ischaemic heart disease
2	Cerebrovascular disease
3	Chronic obstructive pulmonary disease
4	Lower respiratory infections
5	Road traffic injuries
6	Trachea, bronchus, lung cancers
7	Diabetes mellitus
8	Hypertensive heart disease
9	Stomach cancer
10	HIV/AIDS

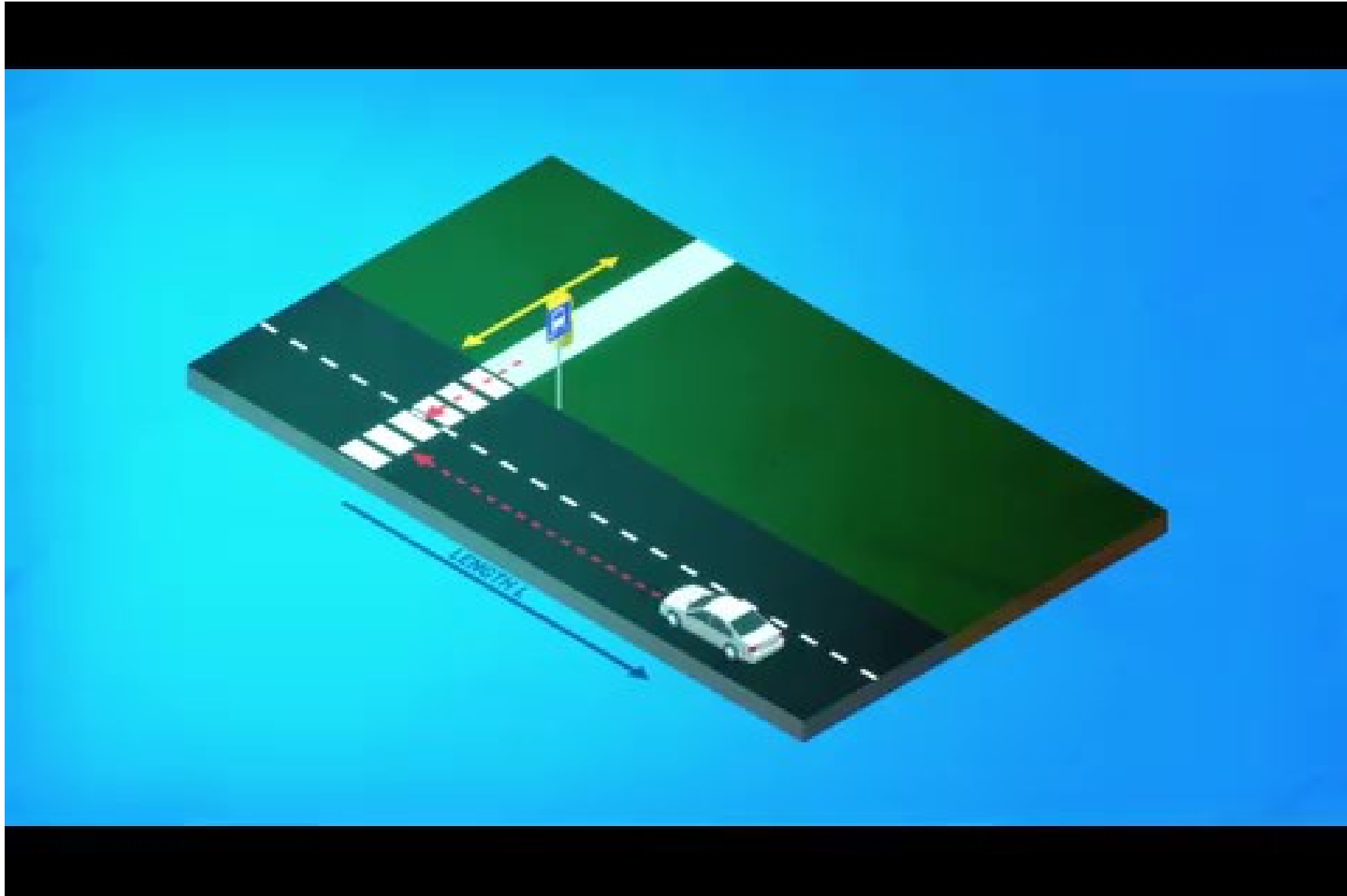
Top 10 leading causes of death, 2004 and 2030

Qualcomm's Prototype Effort

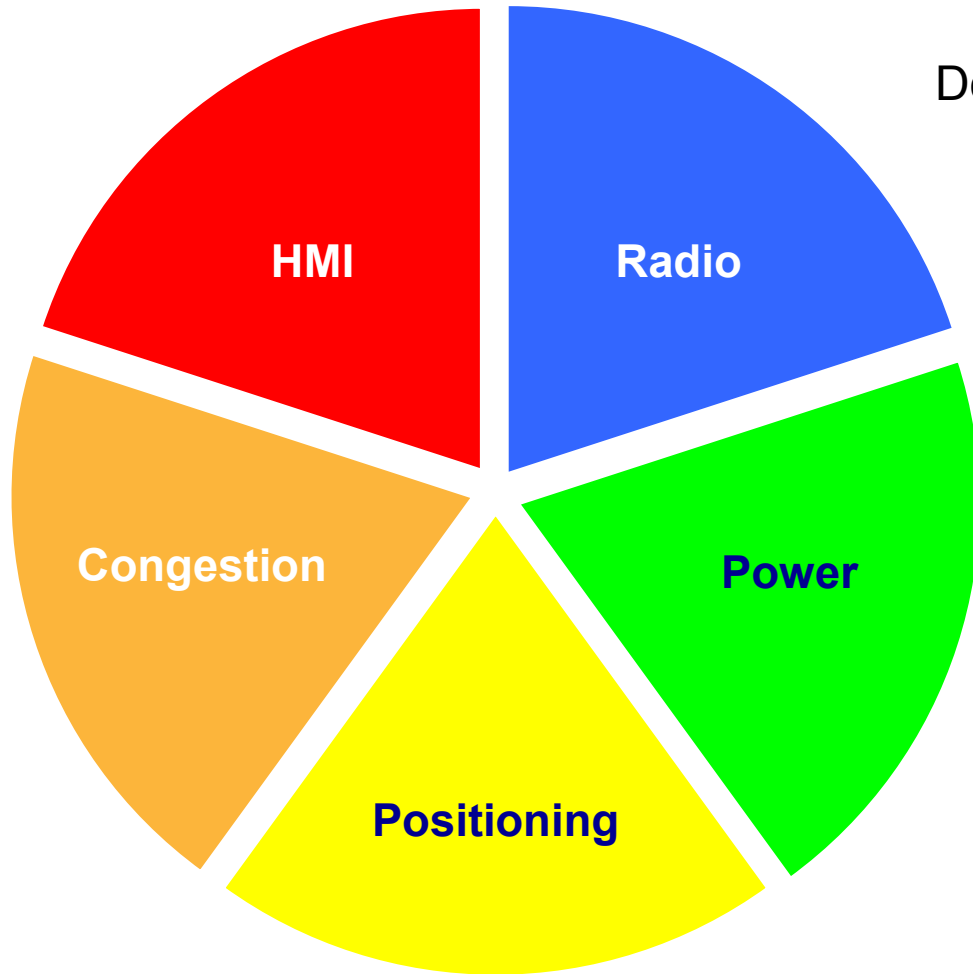
- Main purpose: **Demonstrate smartphones can be used for communications in DSRC band without adding new hardware**
- Enabled DSRC (5.9GHz) band operation in both Qualcomm reference design phones and existing commercial phones
 - Currently doing extensive lab/field measurements and testing
- Integrated with Qualcomm's situational aware capabilities to gate the DSRC operation
- Added safety applications with HMI design to demonstrate the DSRC capability
 - HMI uses both visual and audio warnings



V2P demonstration video



Key Technical Challenges



Does the smartphone have RF capability for DSRC communications? **Radio**

Will DSRC operation exhaust the battery power for smartphones? **Power**

Does the smartphone provide good positioning accuracy? **Positioning**

Will smartphone transmissions cause channel congestion? **Congestion**

How do we design the HMI for smartphone users? **HMI**

Key Enabling Technologies

Context Awareness in Smartphone:

Turn on DSRC at the right moment, based on where you are and what you are doing
Always ON and power efficient



DSRC Capable Wi-Fi Chipsets:

Enable DSRC without adding HW cost
Ride on the high penetration of Wi-Fi chipsets in smartphones



Augmented Positioning:

Improve GPS positioning accuracy
Enhance GPS positioning with Wi-Fi/Cellular connections and sensor information



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Wireless Communications

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Wireless Power

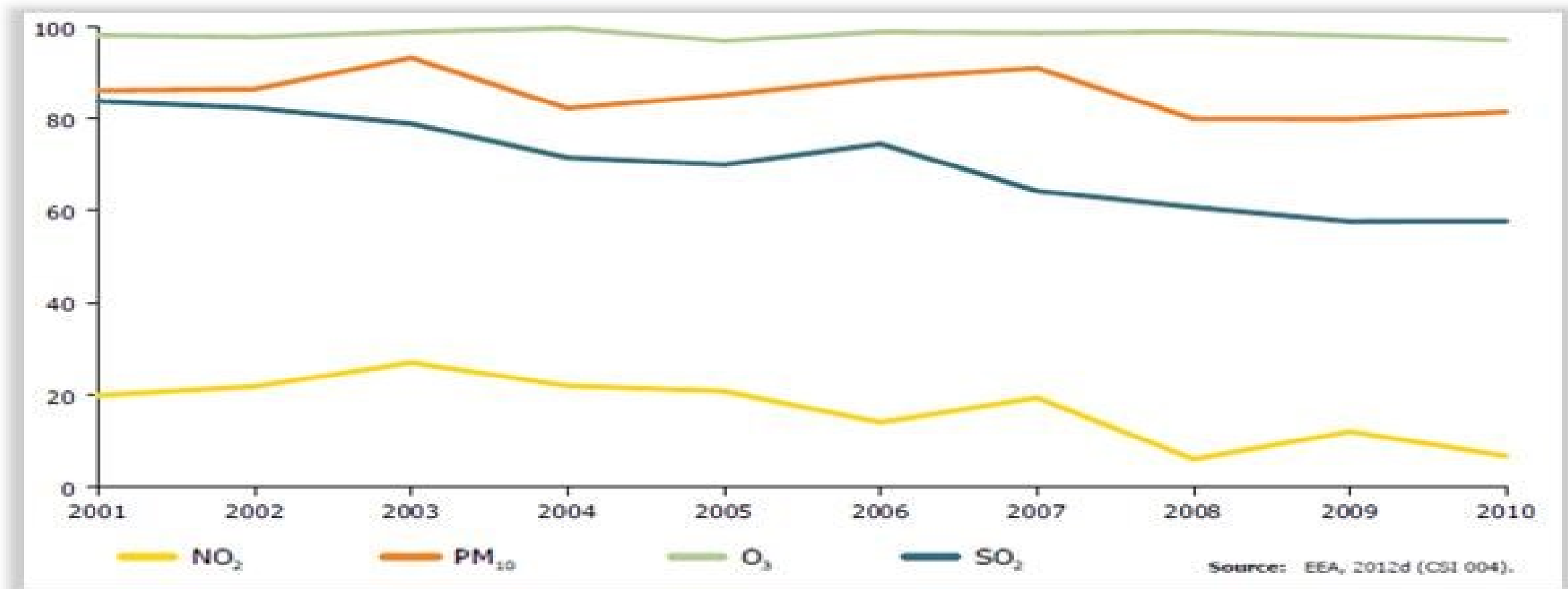
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Air Pollution Is A Major Issue

WHO estimates 2020 health cost of poor air quality = \$200-800B



% of Urban Population in EU exposed to Air Pollution that exceeds WHO's Air Quality Guidelines

Wireless Charging to enable Electric Vehicles

BUSINESS MODEL –
License multiple suppliers

- VSE and BSE
- Unmatched Investments in Innovation
- Foster competition to reduce cost
- Surety of supply
- Comprehensive IP portfolio

STANDARDS–

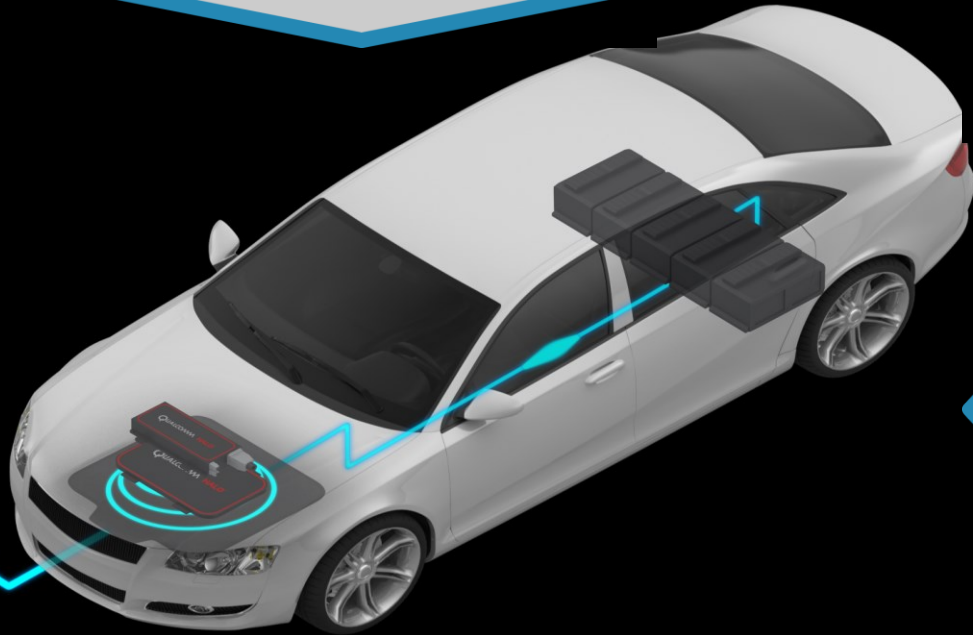
- Influence SAE/DKE/ICE/JSAE
- 85kHz ✓
- Interoperability ✓

PACKAGING / INTEGRATION –
Cross-platform Future Proof

- For multiple vehicle platforms
- Increasing power 6.6kW +
- Cross Company suitability
- Proven Compliant
- Demonstrated integration CAN
- Parallel tuned current source

SAFETY –
Thermal and RF

- Foreign Object Detection
- Living Object Protection
- Circuit protection layers
- Primary/secondary control



PERFORMANCE / ROADMAP –
Power, Vehicle Types, Mode

- Primary/secondary control
- High efficiency >90%
- 3.3, 6.6, 20kW
- Car, Van, SUV
- Stationary, Semi-, Dynamic

COEXISTENCE –
Non-Interfere EMC

- LCL design
- Vehicle Systems
- Implantable Medical Devices
- Communications

COMPLIANCE –
RF Regulations

- In-house expertise
- Simulation methodologies
- At 3, 6 & 20 kW Power Transfer
- Tolerance X/Y and Z to 250mm

ALIGNMENT –
X/Y

- Maintaining compliance to RF regs
- Alignment feedback
- No need for alignment systems
- High Z = flush vs buried deploy

Formula E

Wireless charging with Qualcomm Halo™

- ◆ Enhancing the fan's experience
- ◆ Driving adoption of new technologies for EVs



Towards A Zero Emissions Society



Lower
Air and Noise
Emissions

○ EV Home Charging (easy and cheap energy)

○ EV Charging (convenient and fast)



○ ZEV Lanes (easier access for clean vehicles)

○ Park & Ride (combine Renewables and EVs)

○ Sharing/Mass Transit (solar, wind storage)

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Future Mobility Needs

Zero
Air Pollution

Zero Greenhouse Gas
Emissions

Faster, predictable,
productive travel

Zero Road
Accidents

Mobility for
everyone

Future Vehicles

- Electric-drive
- Connected
- Autonomous
- Purpose-built designs

Future Places

- Smart Grid
- Internet of Everything
- Intelligent Transport System
- Dedicated Zones

Summary

- Qualcomm's roots are in the Connected Vehicle space
- DSRC-enabled smartphones may help accelerate penetration of DSRC technology and support road traffic safety with a 6th sense and greater positioning accuracy; however, significant challenges remain to be solved
- Wireless charging makes EV charging more convenient (near-term), increases adoption of public charging (mid-term) and can reduce the cost of EVs (long-term)
- Wireless technologies under development by Qualcomm (wireless communications and wireless power transfer) have strong potential to support the adoption of connected, electric vehicles and reinvent urban mobility

TRANSPORTATION WILL INCREASINGLY RELY ON WIRELESS TECHNOLOGIES

Thank you

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