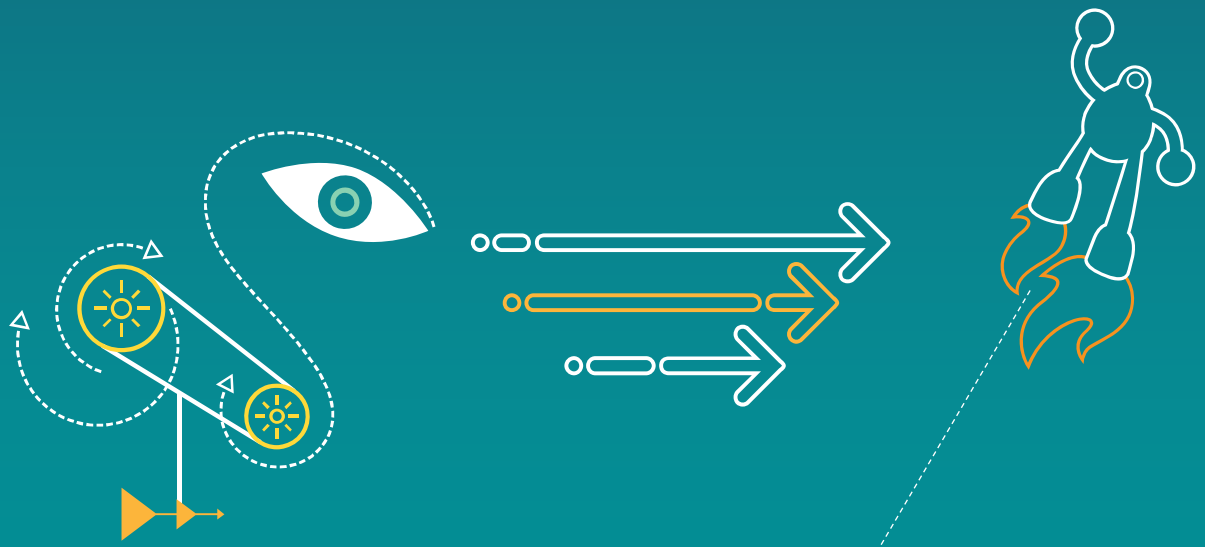
Dr. Chris Borroni-Bird
VP, Strategic Development

Wireless Transportation Solutions

QUALCOMM®



1 Societal/Mobility Trends

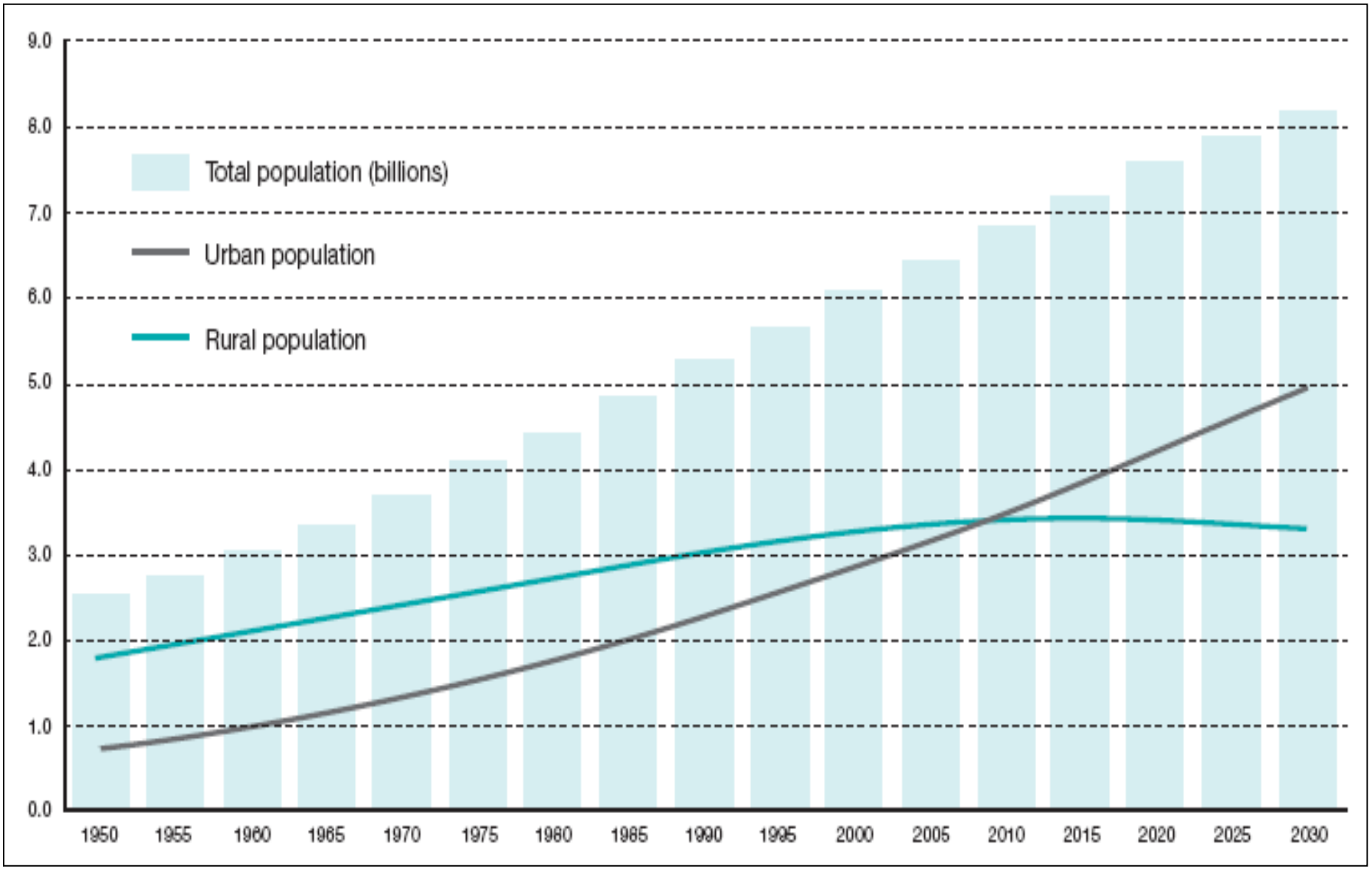
2 Wireless Power

3 Wireless Communications

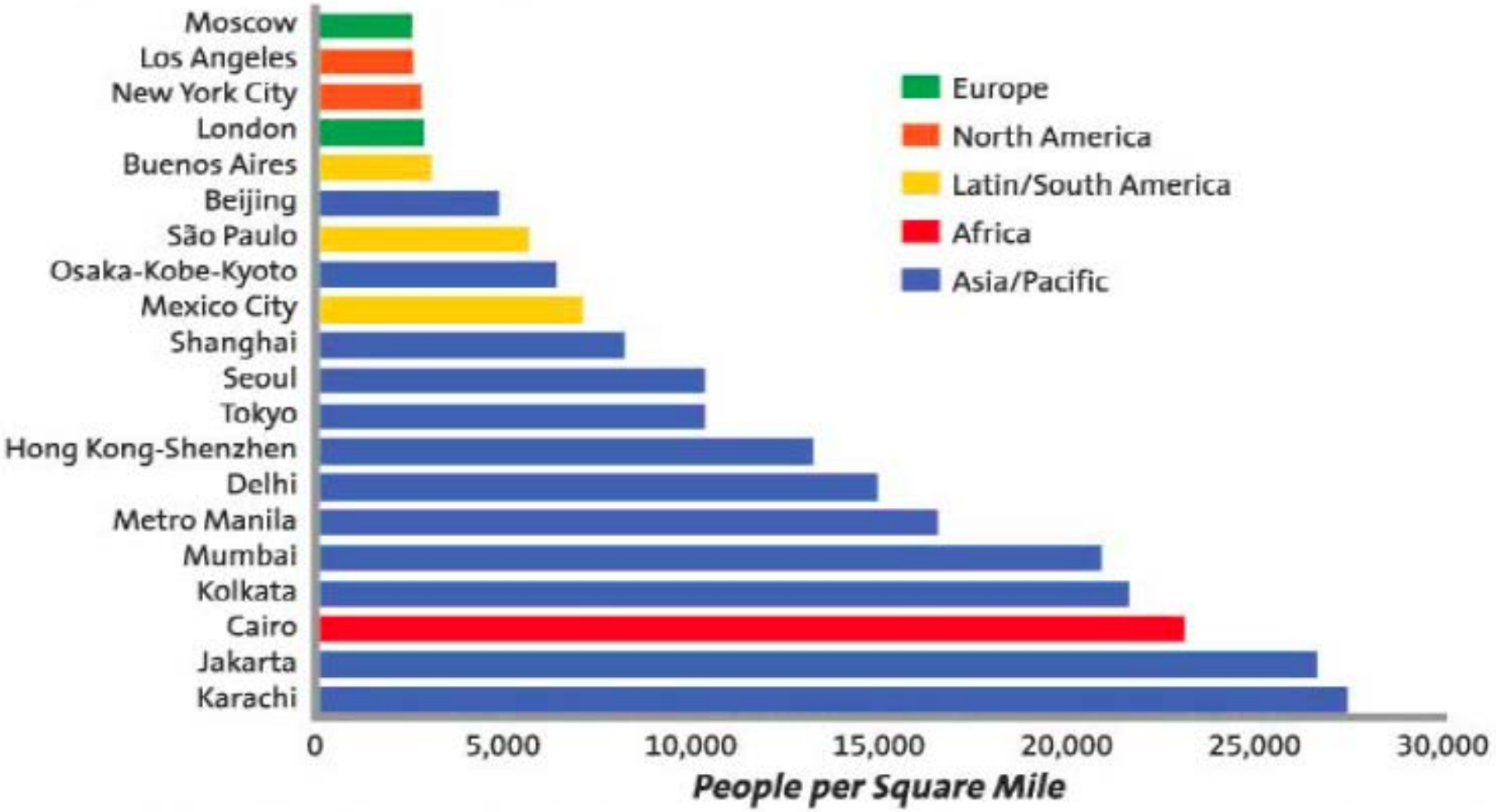
4 Summary

Agenda

The World Is Urbanizing

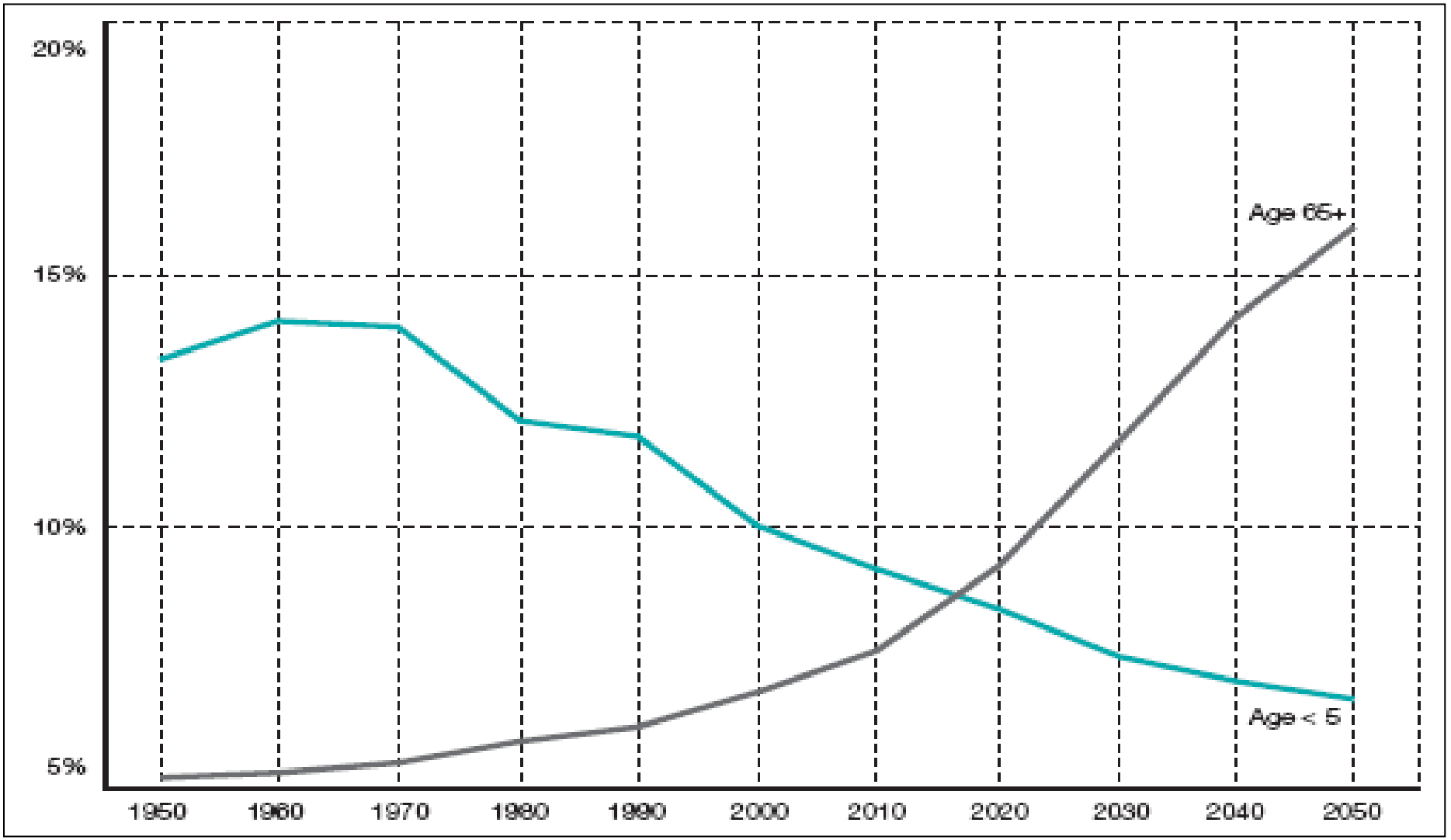


Developing Cities Tend To Be Densest



Source: R.L. Forstall, R.P. Greene, and J.B. Pick, City Futures Conference, (University of Illinois at Chicago, July 2004)

The World Is Aging



Source: UN Population Division

Millennials Think About Mobility Differently

The Trends: Today's Youth Drive Less and Use Transportation Alternatives More

Today's Youth Drive Less

Today's Youth Increasingly Use Transportation Alternatives

Today's Youth Avoid or Postpone Buying Cars and Acquiring Driver's Licenses

Americans Move to More Urban Areas with More Transportation Alternatives

Young People's Priorities and Preferences Are Leading Them to Drive Less

Young People Choose to Replace Driving with Alternative Transportation

Young People Want to Live in Places with Transportation Alternatives

The Trend Toward Reduced Driving Among Young People Is Likely to Persist

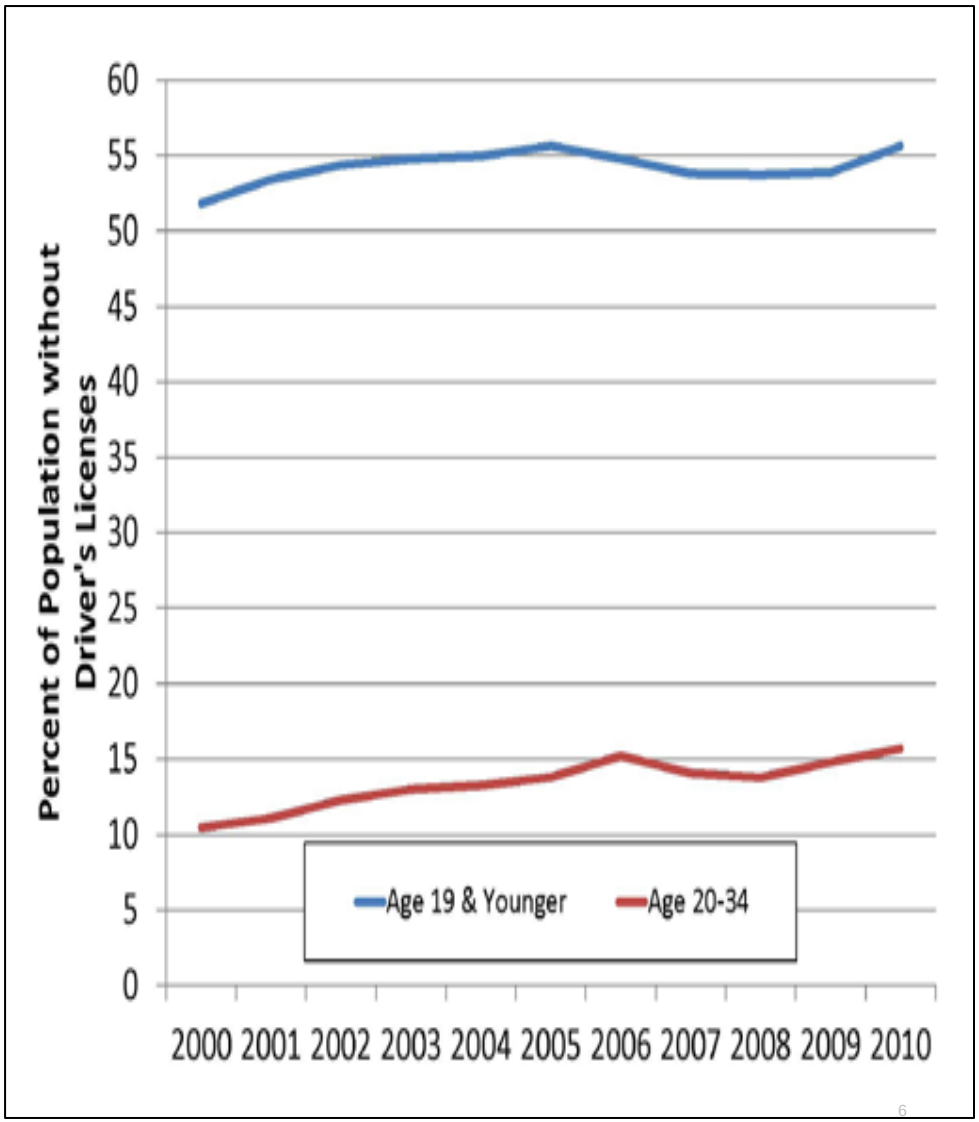
Communication Technology Substitutes for Driving and Supports Alternative Transportation

Driver's License Restrictions Postpone Young People from Obtaining Licenses

Increased Fuel Prices Push People to Cheaper Transportation Alternatives

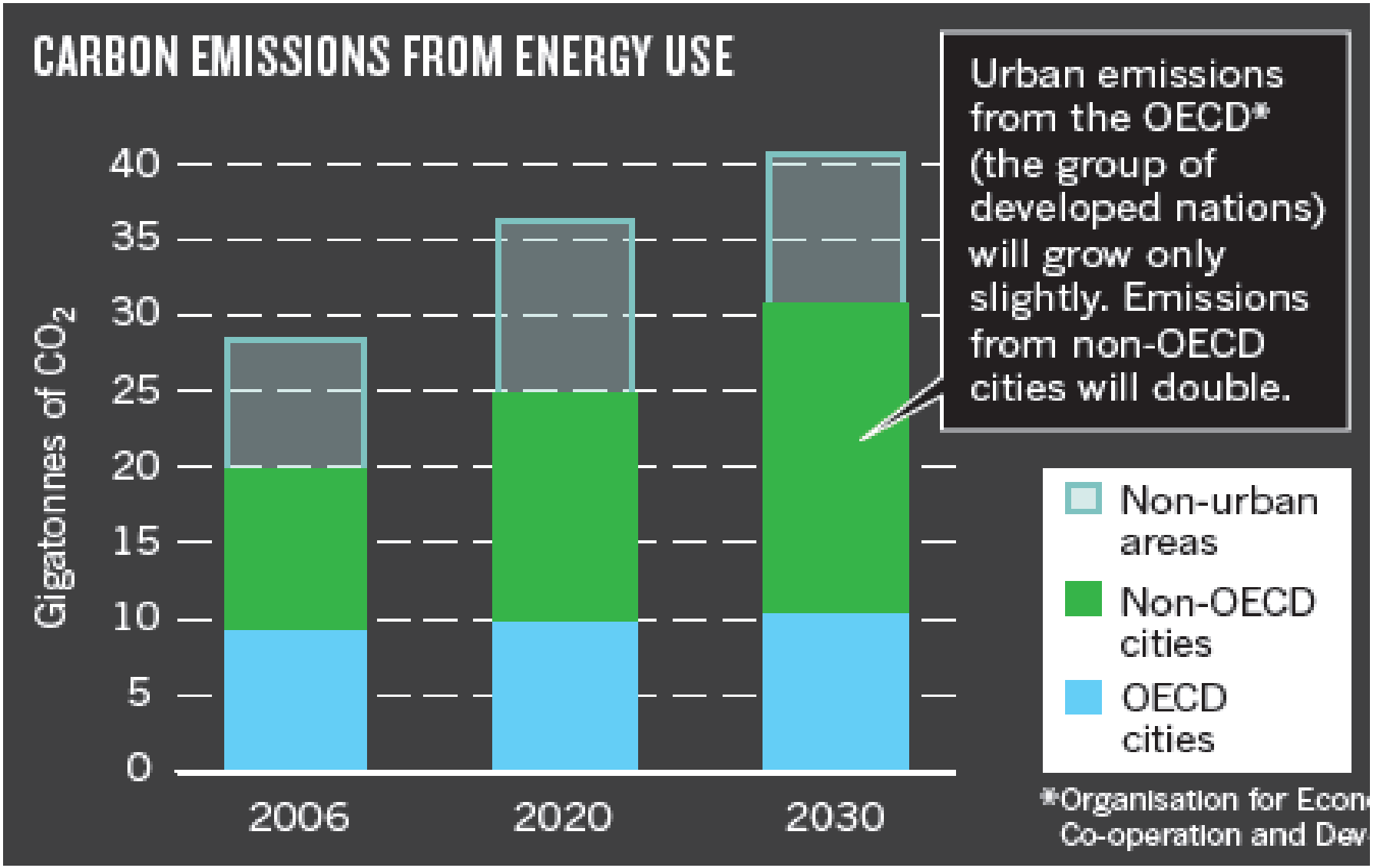
Some Young People Reduce Their Driving to Protect the Environment

The Trend Toward Reduced Growth in Driving Will Likely Persist Even When the Economy Rebounds



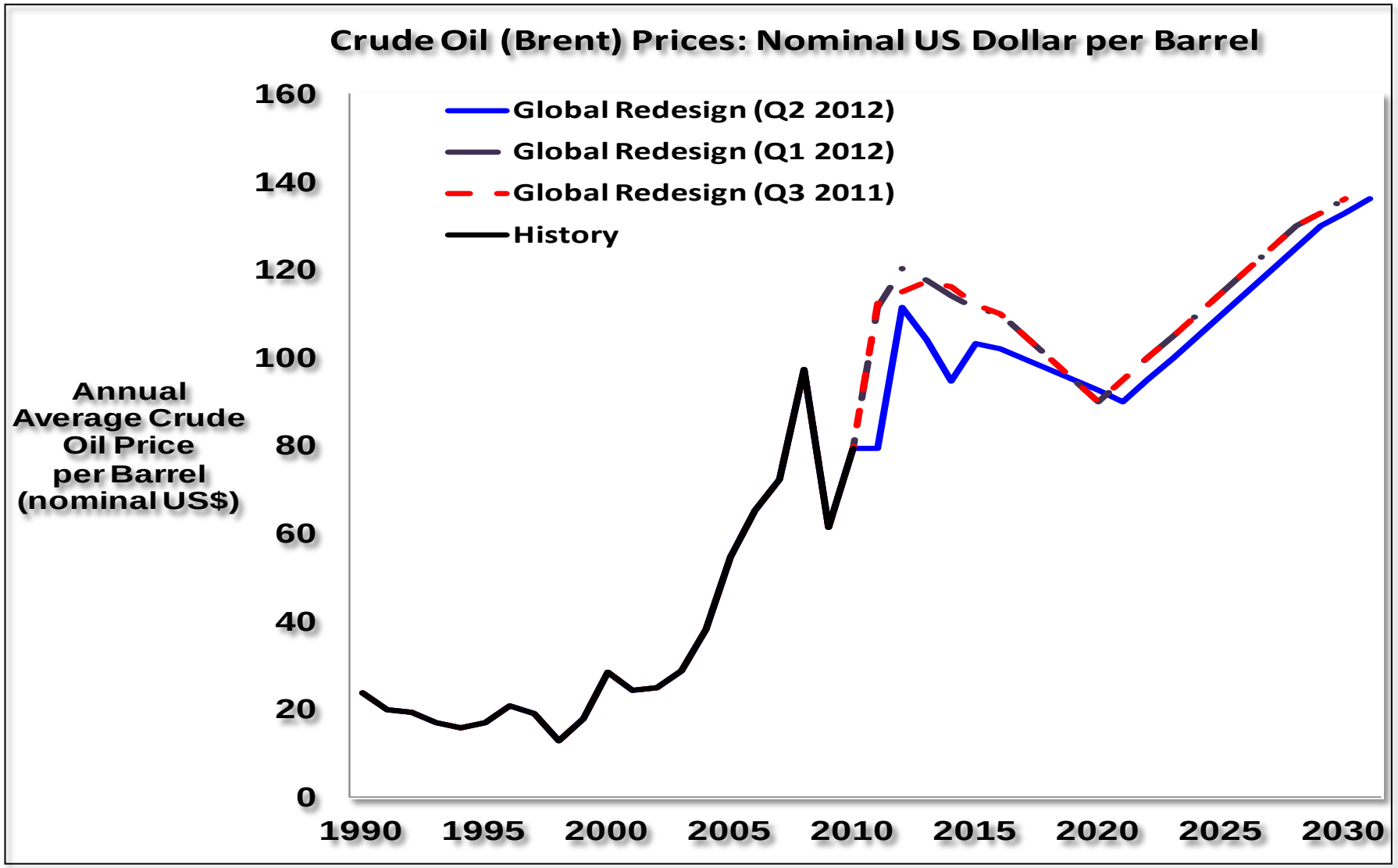
Source: "Transportation and the New Generation", 2012

Urban CO_2 Emissions Will Dominate



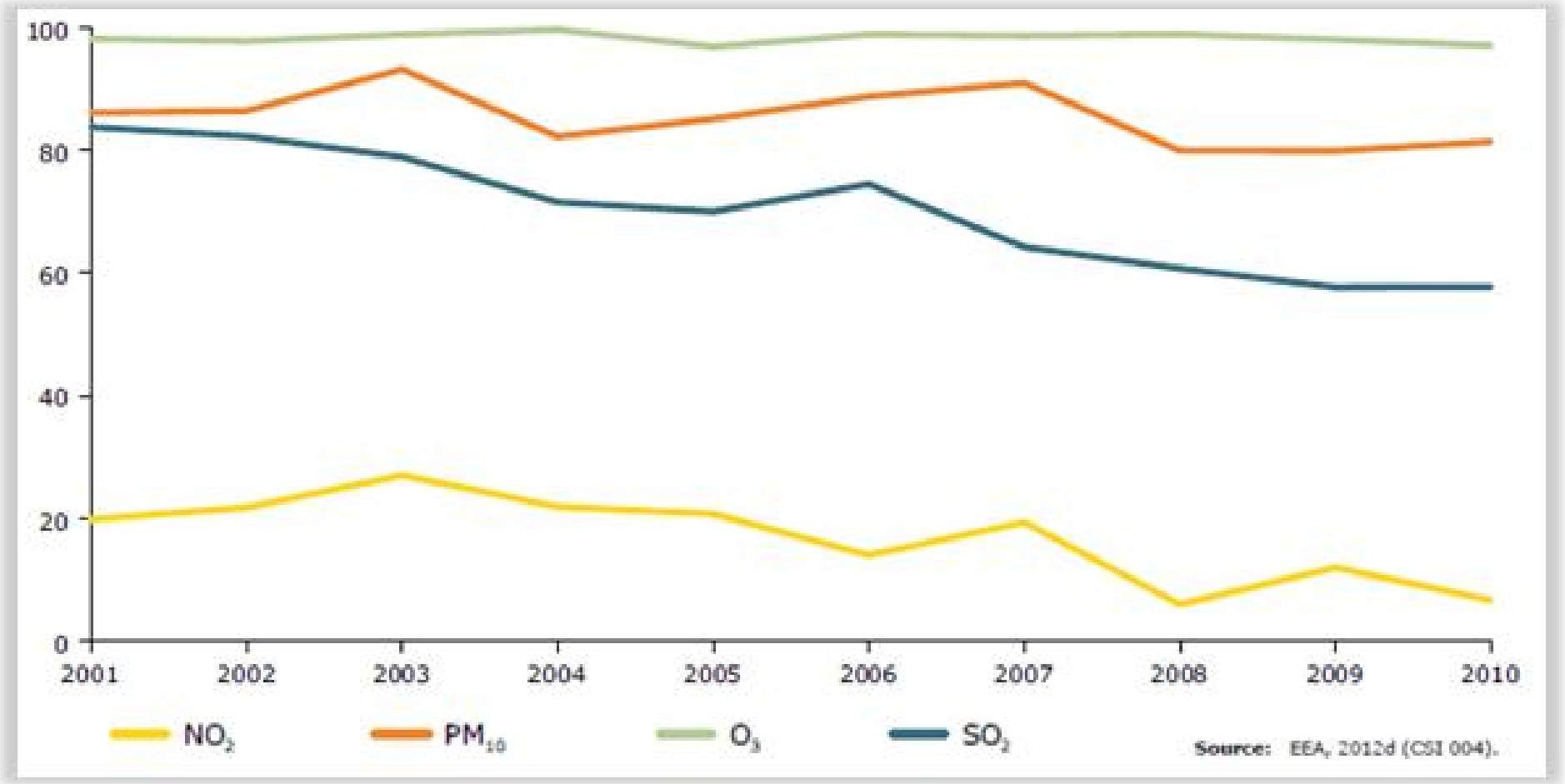
Source: IHS CERA

Petroleum Prices Are Likely To Increase



Source: IHS CERA. *Brent.

Air Pollution Is Still A Major Issue



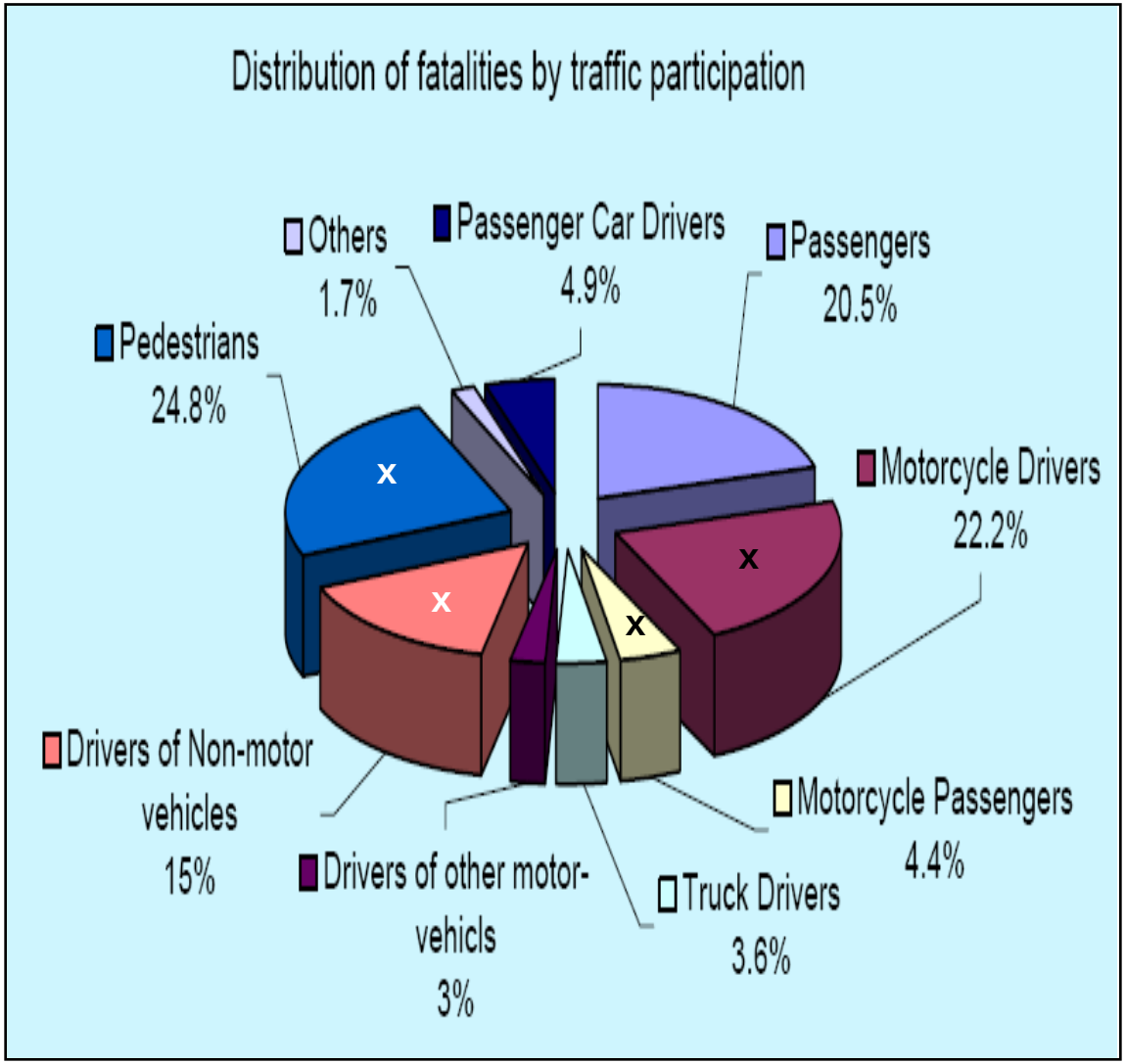
% of Urban Population in EU exposed to Air Pollution that exceeds WHO's Air Quality Guidelines

WHO estimates monetized health impact of poor air quality in 2020

$200 – 800B per year

Source: Air Quality in Europe. EEA 2012

Traffic Safety Improvements Needed



Top 10 leading causes of death, 2004 and 2030 compared

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

Source: China Traffic Data 2000-2005; Saving Millions of Lives. WHO 2008

What Type Of “Car” Does The City Need?

City Objectives	No Pollution (air, noise)	Renewable energy sources	Safety for all road users	Faster, more predictable travel times	Accessibility for All	Reduced parking space requirements	Beautiful Urban Design

Electrification, Connectivity and Appropriate Design

Future “Car”	▪ **Connectivity and Autonomy** ▪ **Electrification** ▪ Purpose-built vehicle designs?
Future City	▪ **Internet of Everything** ▪ **Smart Grid** ▪ Dedicated roads or zones?

1 Societal/Mobility Trends

2 Wireless Power

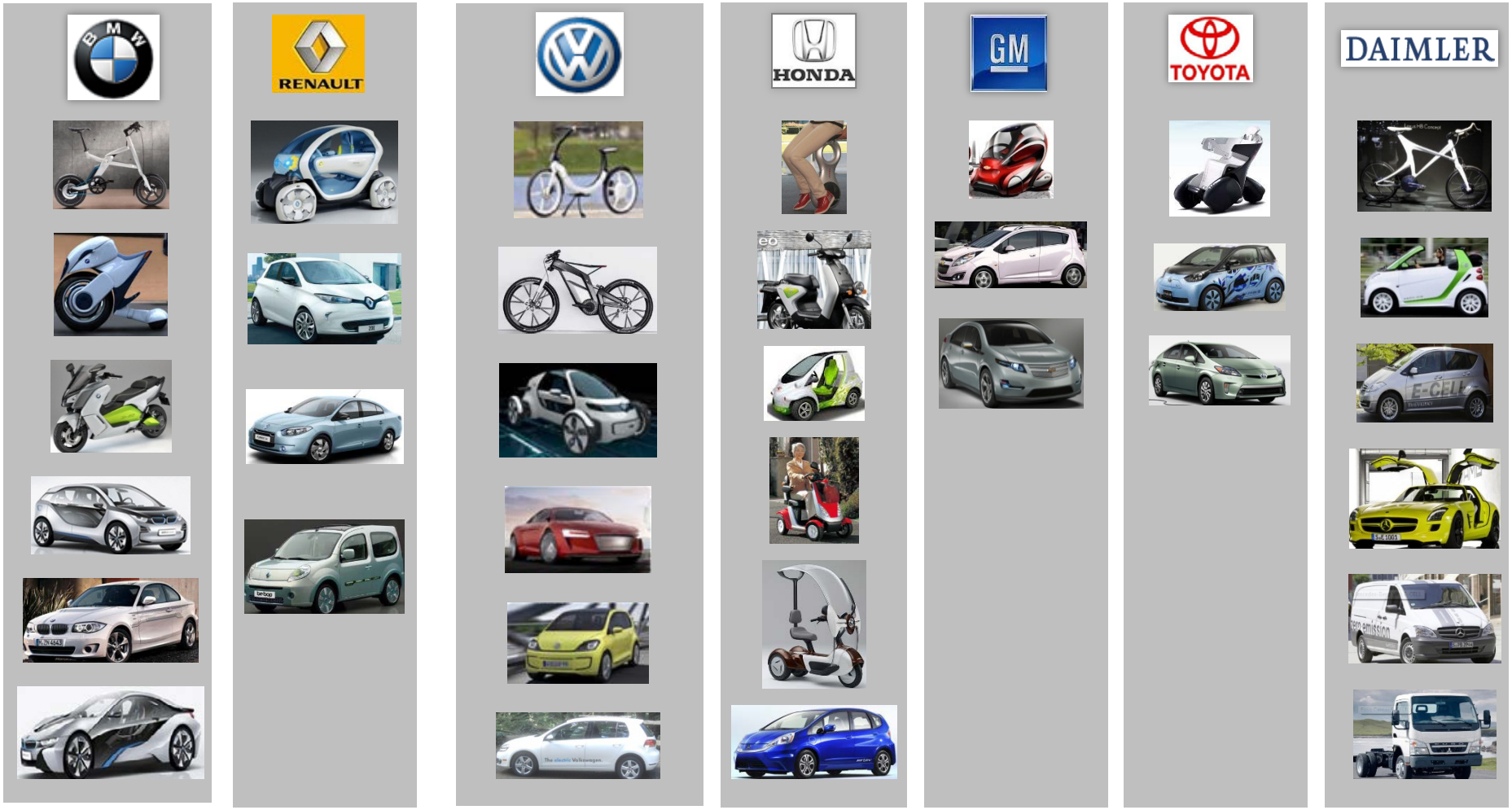
3 Wireless Communications

4 Summary

Agenda

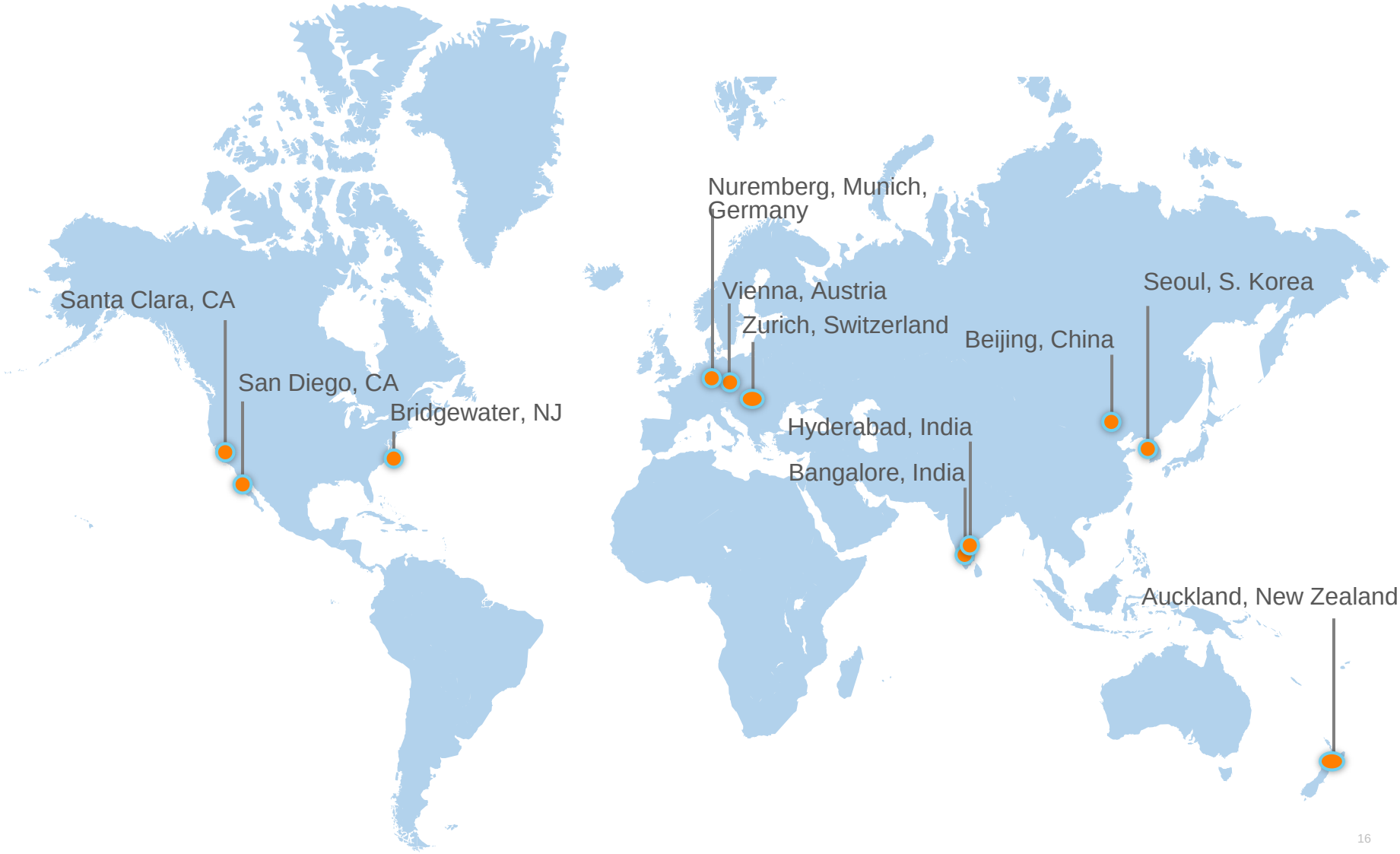
Ever-Increasing EV Choices

- Major Automakers have announced EVs at all levels across the electromobility spectrum
- Manufacturers have announced 125 micro-mobility models globally…50% are electric



Source: 360-degree Perspective of the Global Electric Vehicle Market—2012 Edition. Frost & Sullivan. June 2012.

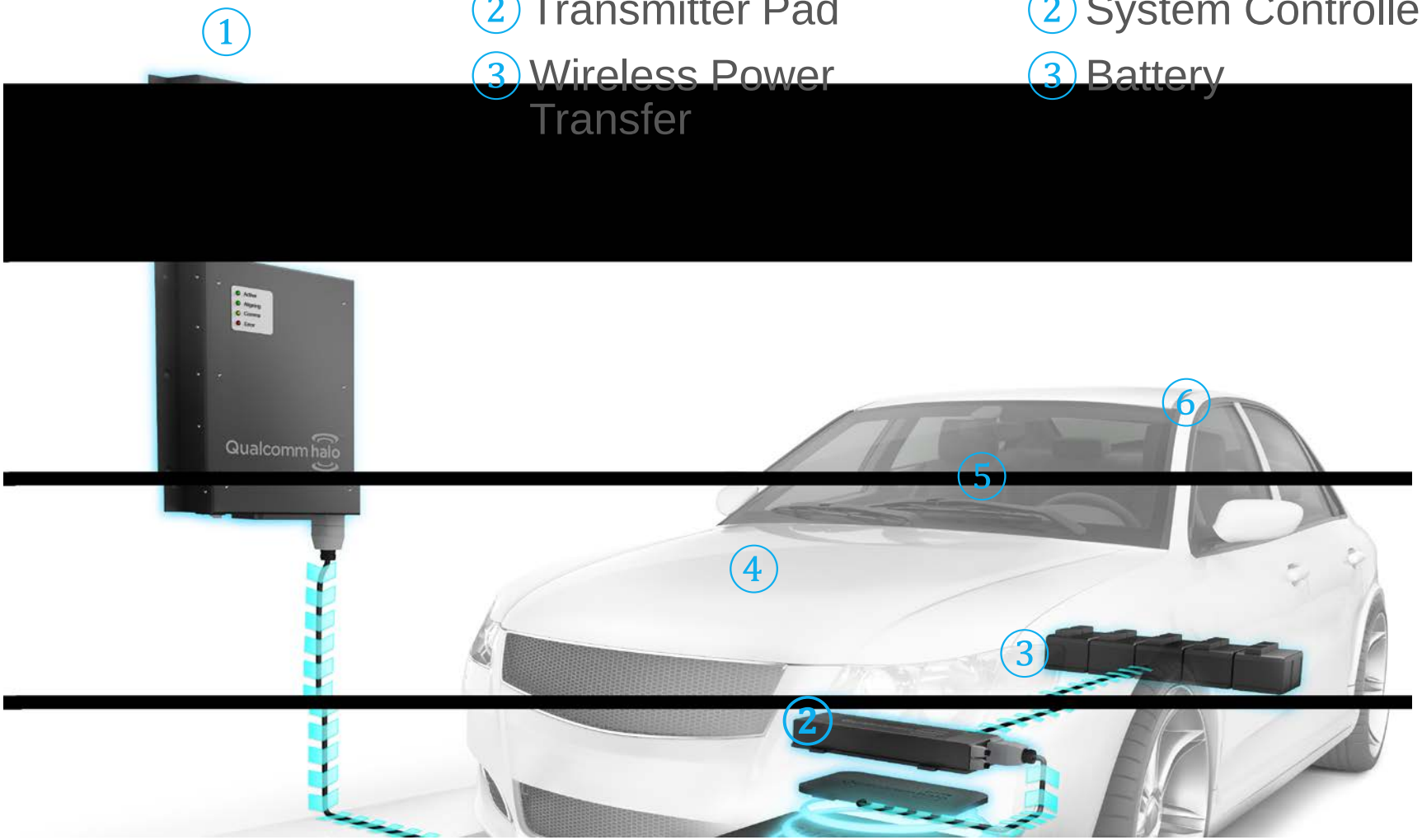
Global R&D Organization



Wireless EV Charging: Qualcomm Halo

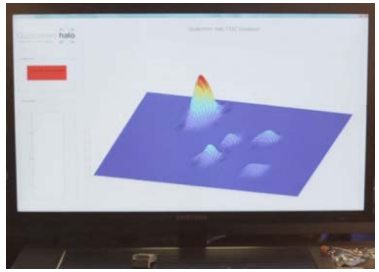
1. Power Supply
2. Transmitter Pad
3. Wireless Power Transfer

1. Receiver Pad
2. System Controller
3. Battery



Qualcomm's Complete WEVC Solution

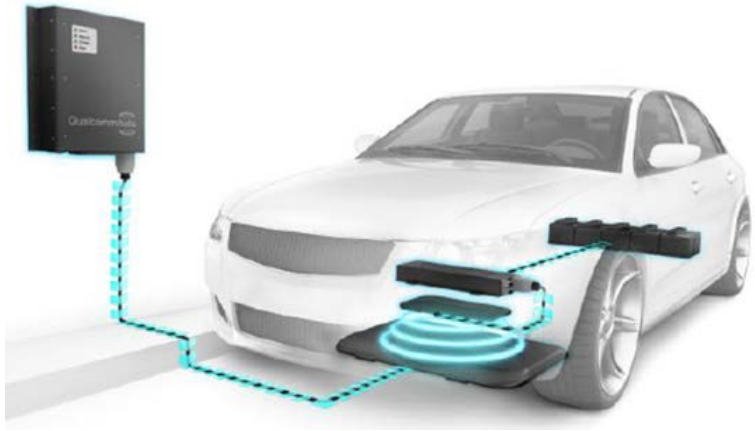
IPT Magnetics



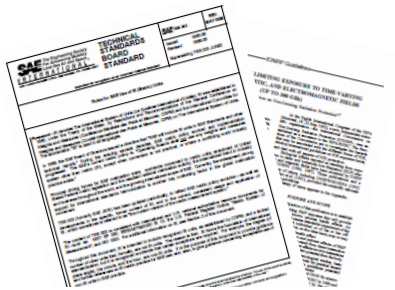
Auxiliary: FOD, LOP

QUALCOMM

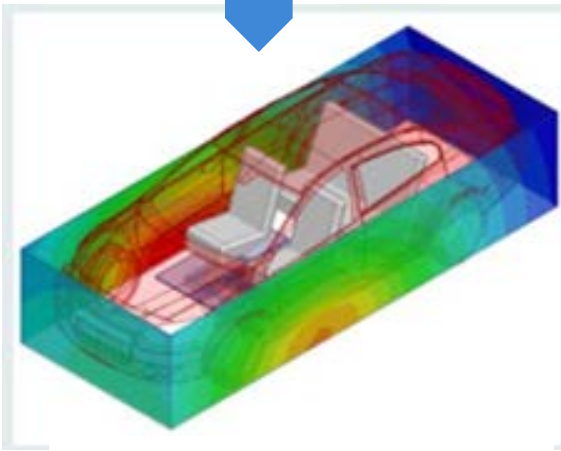
Communication



Application -
System integration



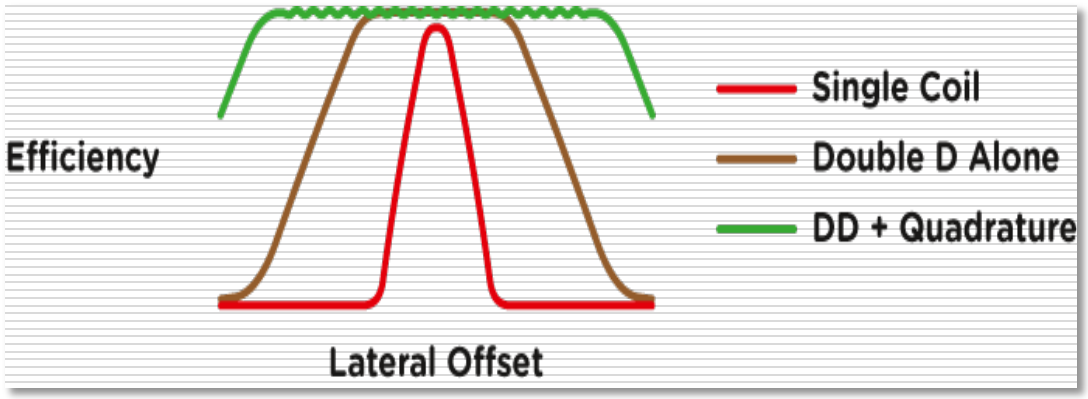
Standards



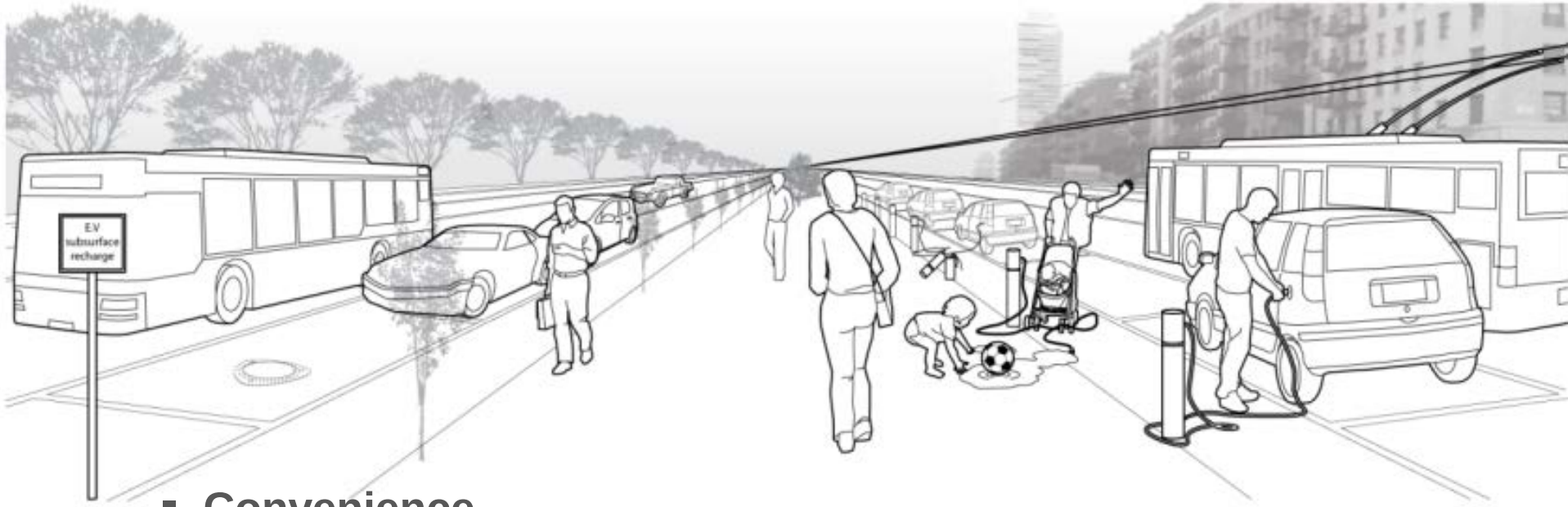
Compliance

Halo Solution Is Flexible And Scalable

- Simple, **effortless** and convenient
- **Compact** size, easy to package on EV
- Unique proprietary flux pipe DDQ magnetics
- High **efficiency**
- **Tolerance** to lateral misalignment (X/Y)
- Tolerance to large variations in vertical **gap** (Z)
- **Interoperable** with different pad topologies
- Enables **dynamic charging**

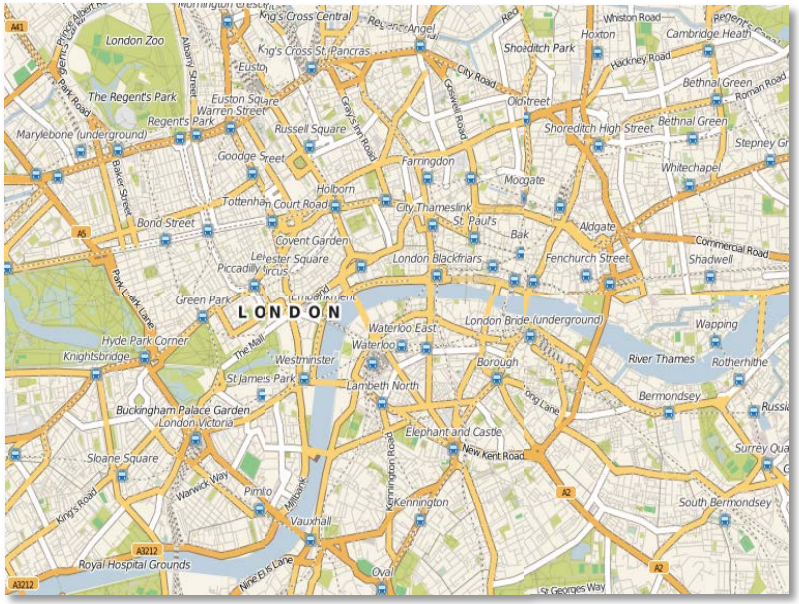


Wireless EV Charging Has Many Benefits



- **Convenience**
- Simplicity
- Hassle Free
- Flexibility
- **Urban Planning Easier**
- Charge Little and Often
- **Reduced Battery Size and EV Cost**

Halo’s London Trial

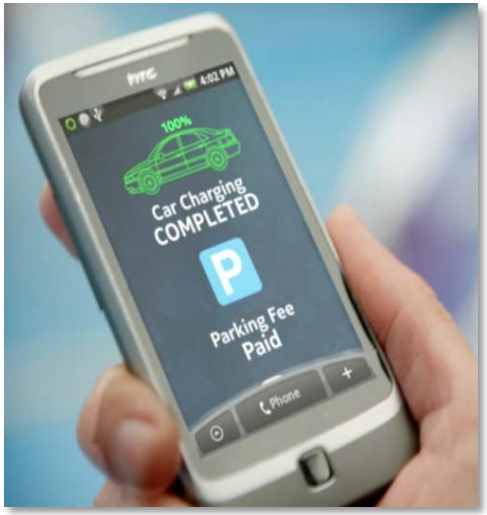


- Understand EV **integration**, packaging & **deployment**
- Generate technical data & **user feedback**
- Create **demonstration**/test environment for OEM’s WEVC
- **Promote** EVs by demonstrating wireless charging as effortless
- Test various **use-cases** for EVs – Taxis, Carshare, Fleets & Private cars
- Identify broader technical, commercial & **regulatory** issues

Trial Will Learn About Charging Behavior

- How do user's emotions & charging behavior differ when charging wirelessly vs plugging-in?
- To understand changes to the user experience

- Drivers use a plug-in vehicle for a few months and upgrade to wireless, recording experiential change



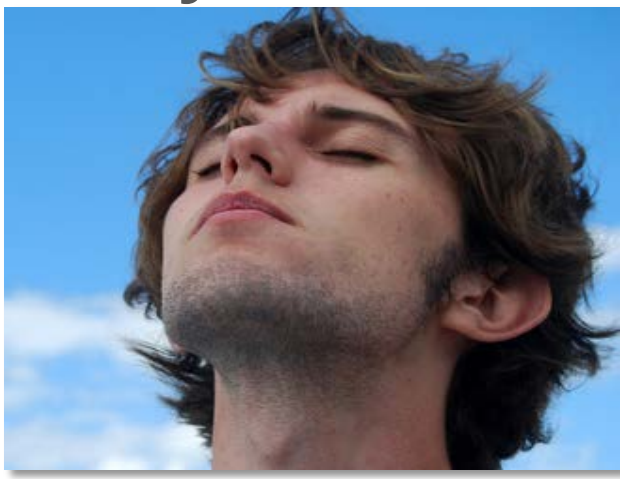
- Data is analyzed from vehicles and charging points

- Drivers complete questionnaire to probe the softer issues

Towards A Zero Emissions Society

- EV Home Charging (easy and cheap energy)

- EV Charging (convenient and fast)



- Zero Emissions Urban Areas (reduce noise & air pollution)

- Zero Emissions Road Lanes (easier access for clean vehicles)

- Park & Ride (combine Renewables and EVs)

- Sharing and Public Transport (EV is storage for solar, wind)

1 Societal/Mobility Trends

2 Wireless Power

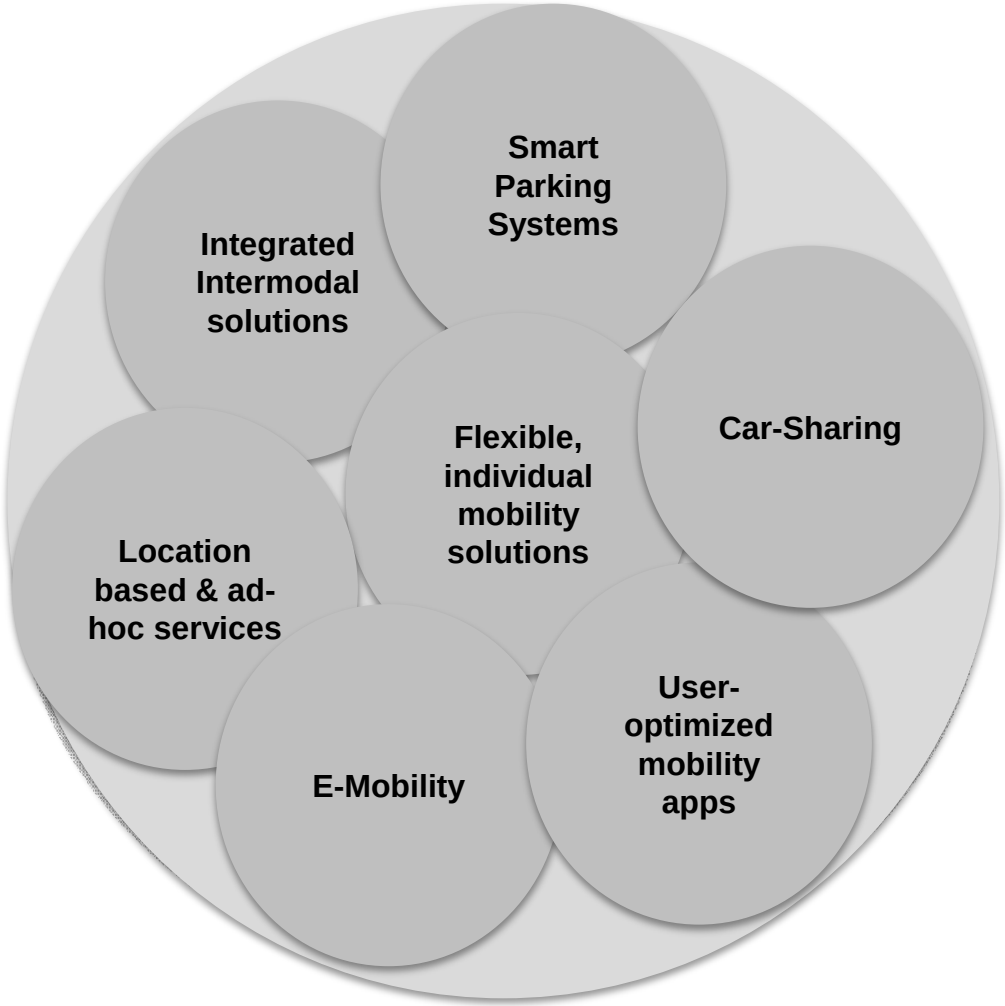
3 Wireless Communications

4 Summary

Agenda

Connectivity - Key To Sustainable Mobility

1. Urbanisation & Globalisation
2. Connectivity
3. Regulation & Sustainability
4. Convenience
5. Change of values
6. Individuality
7. Demographic Changes



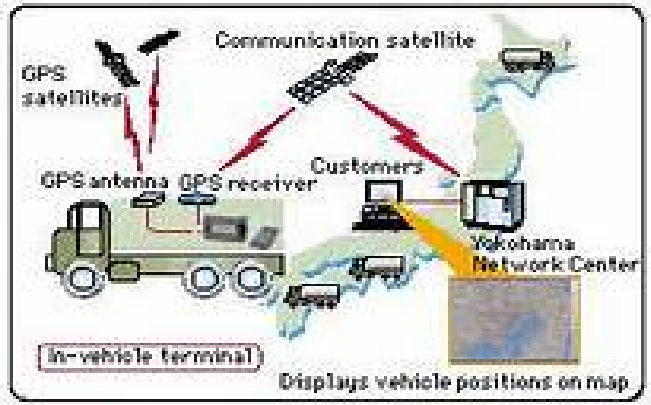
Source: DriveNow

Qualcomm's Roots - Connected Vehicles

~1988: OmniTRACS

Two-way satellite based Fleet Management Tracking and Logging

1.5M units in 39 countries, 10k customers



- OmniTRACs is a mobile information system that is used extensively in the Trucking industry
- OmniTRACS has safety features that ensure drivers focus on the main task of driving
  - *Standard user interface reduces potential for driver distraction by restricting drivers from typing, sending or reading messages on the display unit while the vehicle is moving*
  - *Drivers are able to use only critical applications while the vehicle is in motion, using the "text-to-speech" feature*

Products Enable Connected Vehicles

Functions

Cellular Modem | Application Processor | GNSS | WiFi | Bluetooth | NFC | HPGP

Subsystems

Telematics Control Unit (Safety and Security)	Head / Infotainment Unit (Infotainment)	Aftermarket Products (infotainment, telematics)	Connectivity (Hands-free, WiFi access point, USB)	Public and Private Charging Stations

Future Technologies

- **Wireless Charging (WiPower)**
- **EV Wireless Charging (Halo)**
- **DSRC**
- **Single pair Ethernet**

Mobile Meets Mobility

Navigation Services

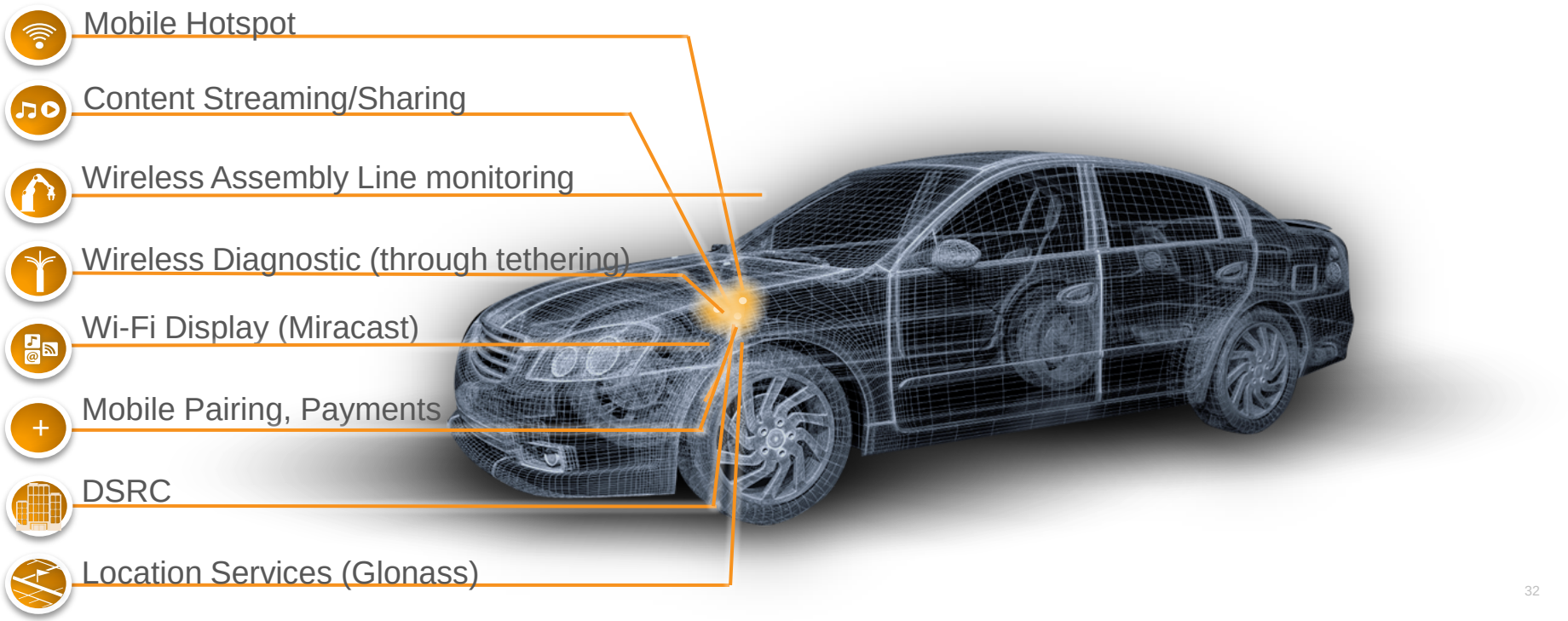
Application Downloads

Content Streaming

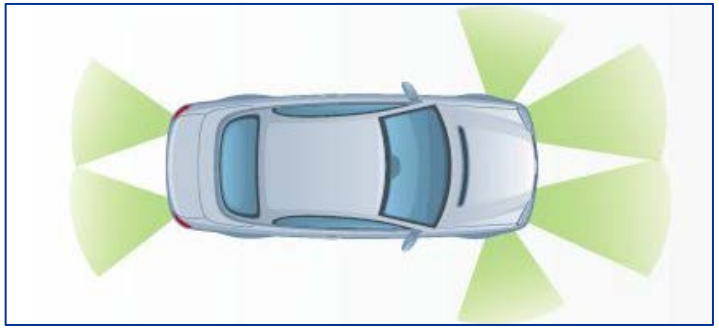
Mobile Hotspot

Safety and Security

Wireless EV Charging

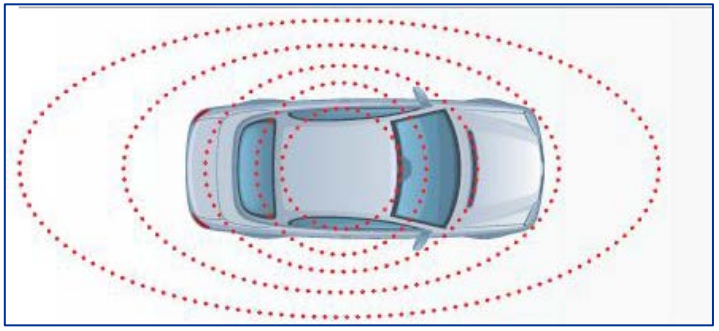


Fusion Of Sensing And Communications



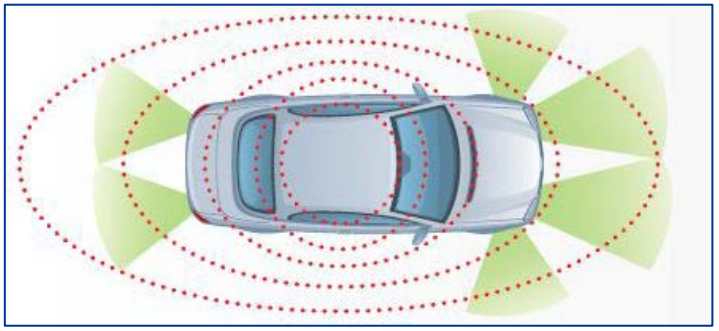
Sensor-based Solution Only

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



Connected Vehicle Solution Only

- Dedicated Short Range Communication (DSRC) does not currently work with pedestrians, bicyclists, etc.
- DSRC-based Vehicle to Infrastructure (V2I) might require significant infrastructure investment
- Vehicle to Vehicle (V2V) requires high market penetration

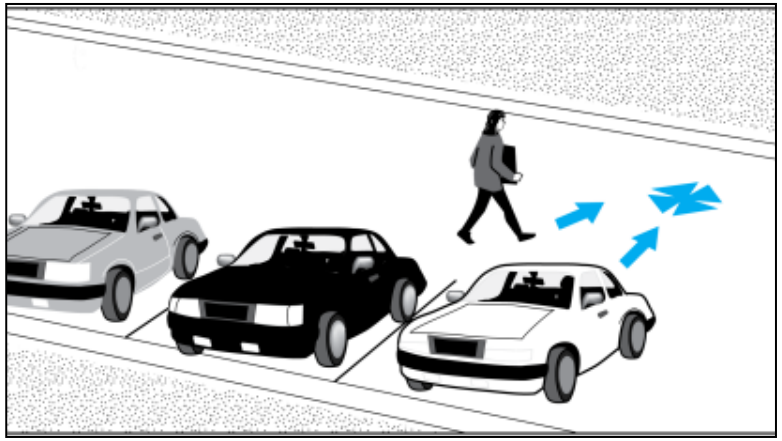


Converged solution

- Convergence will facilitate adequate mimicking of human senses
- Convergence will reduce need for an expensive mix of sensors and reduce the need for blanket V2I investment
- Convergence provides functional redundancy to ensure that the technology will work 100 percent of the time

Smartphones For ITS Applications

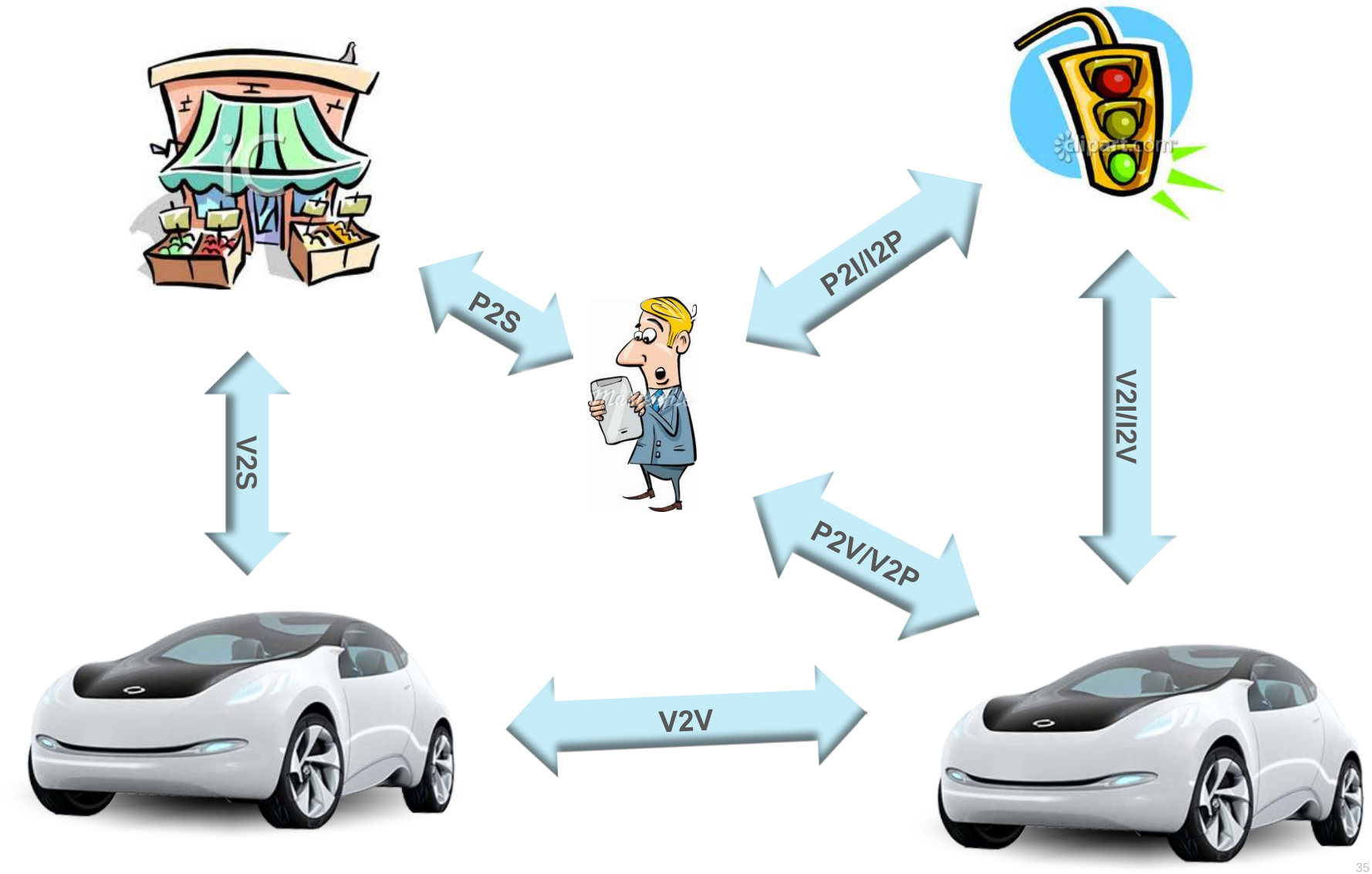
- **Two issues with current V2V strategy may be helped with DSRC-smartphone**
  - *Safety application effectiveness relies on high penetration*
  - *Vulnerable road users (pedestrians and cyclists) are not explicitly addressed*



- **Smartphone as a vehicle aftermarket device**
  - *50% DSRC vehicle market penetration of entire vehicle fleet may take 10 - 20 years*
  - *45% of Americans use a smartphone and this percentage is growing*
  - *Average smartphone lifetime ~ 2 years → vehicle market penetration (50%) in < 5 years*

- **Smartphone as a personal safety device**
  - *P2V (pedestrians broadcast their presence to vehicles when appropriate)*
  - *V2P (pedestrians receive safety / emergency messages from vehicles)*

DSRC in Smartphone Use Cases



1 Societal/Mobility Trends

2 Wireless Power

3 Wireless Communications

4 Summary

Agenda

Summary

- The world's population is increasingly urban, aging and valuing access over ownership. These trends challenge the traditional automobile and automotive business
- A new solution is required to preserve personal mobility and it will rely on vehicle electrification and connectivity
- Wireless technologies under development by Qualcomm (wireless power transfer and wireless communications) have potential to underpin this solution

THE FUTURE OF TRANSPORTATION WILL INCREASINGLY RELY ON WIRELESS TECHNOLOGIES