Wireless Transportation Solutions
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

Urban CO₂ Emissions Will Dominate

CARBON EMISSIONS FROM ENERGY USE

Urban emissions from the OECD* (the group of developed nations) will grow only slightly. Emissions from non-OECD cities will double.

Source: IHS CERA
Petroleum Prices Are Likely To Increase

Source: IHS CERA. *Brent.
Air Pollution Is Still A Major Issue

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

**Distribution of fatalities by traffic participation**

- **Pedestrians** 24.8%
- **Passenger Car Drivers** 4.9%
- **Motorcycle Drivers** 22.2%
- **Motorcycle Passengers** 4.4%
- **Drivers of Non-motor vehicles** 15%
- **Drivers of other motor vehicles** 3%
- **Truck Drivers** 3.6%
- **Others** 1.7%

**Passengers** 20.5%

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

**Top 10 leading causes of death, 2004 and 2030 compared**

**2004**

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**

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
What Type Of “Car” Does The City Need?

City Objectives
- Reduced parking space requirements
- Safety for all road users
- Faster, more predictable travel times
- Accessibility for All
- Reduced parking space requirements
- Beautiful Urban Design

Future “Car”
- Connectivity and Autonomy
- Electrification
- Purpose-built vehicle designs?

Future City
- Internet of Everything
- Smart Grid
- Dedicated roads or zones?

Electrification, Connectivity and Appropriate Design
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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.

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

Application - System integration

Communication

Auxiliary: FOD, LOP

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)
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Connectivity - Key To Sustainable Mobility

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

- Integrated Intermodal solutions
- Smart Parking Systems
- Flexible, individual mobility solutions
- Location based & ad-hoc services
- E-Mobility
- User-optimized mobility apps
- Car-Sharing

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

- Mobile Hotspot
- Content Streaming/Sharing
- Wireless Assembly Line monitoring
- Wireless Diagnostic (through tethering)
- Wi-Fi Display (Miracast)
- Mobile Pairing, Payments
- DSRC
- Location Services (Glonass)
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 $\rightarrow$ 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
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- 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