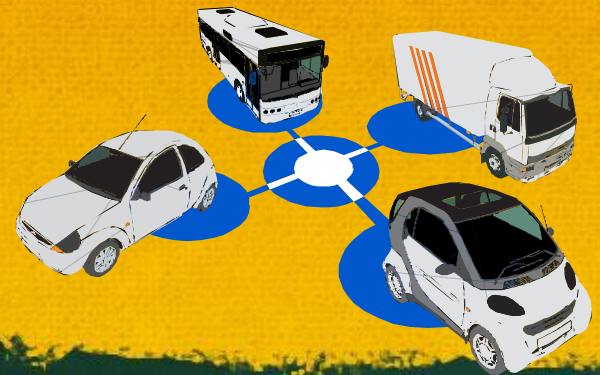


# Personal Mobility: Disruptive Technology in the Next Decade

An Integrated Assessment  
Graham Institute, Sept 7, 2012  
CVPC in partnership with CATES





# The Problem



# The Numbers

- Safety
  - 33,963 deaths/year (2009), 5.8M crashes/year, 2.5M injured
  - Leading cause of death for ages 4 to 34
  - Direct economic cost of \$230.6 billion (US 2000 data)
- Mobility: Non-productive time
  - 4.2 billion hours of travel delay
  - \$78 billion cost of urban congestion
- Environment
  - 2.9 billion gallons of wasted fuel
  - Deterioration in air quality – 28% of US Greenhouse Gas Emissions due to congestion



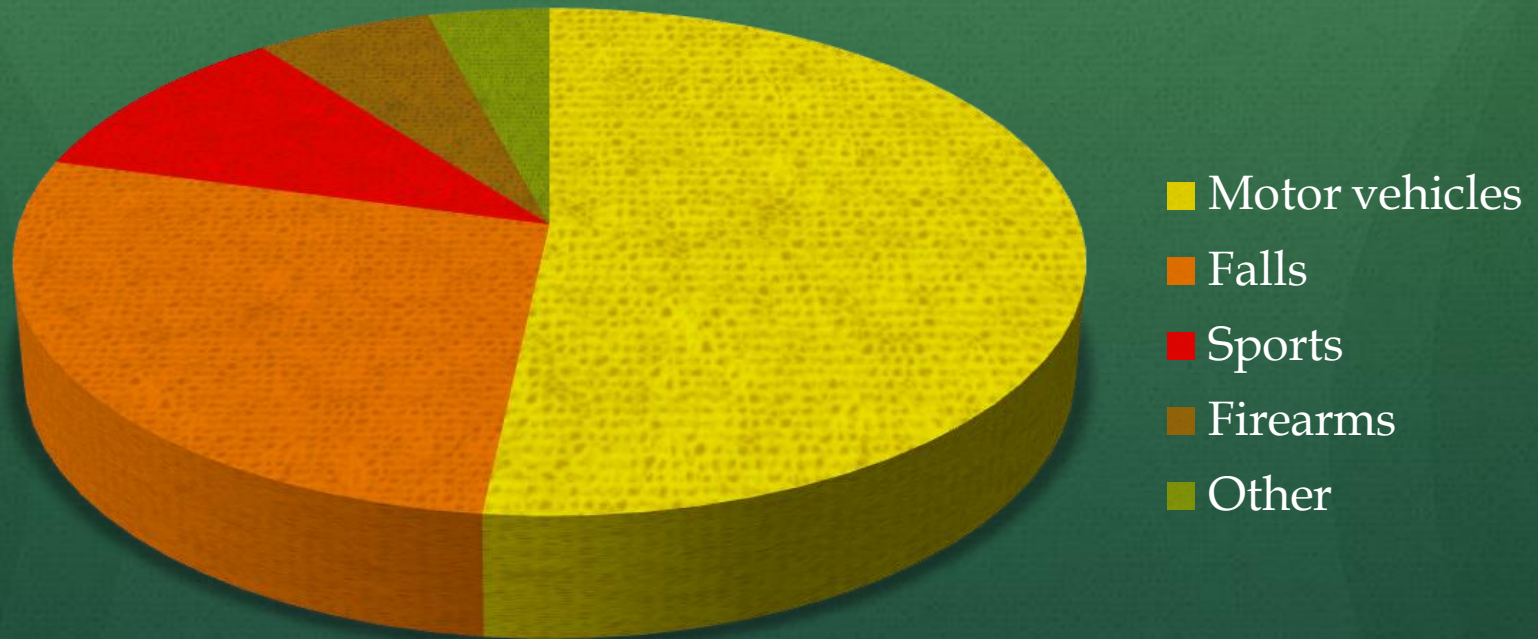
# Leading Causes of Death USA 2009

Major Cardiovascular Diseases	936,923
Malignant Neoplasms	553,091
Chronic Lower Respiratory Dis.	122,009
Diabetes Mellitus	69,301
Influenza and Pneumonia	65,313
Alzheimers	49,558
Motor Vehicles*	33,963
Renal Failure	36,471
Septicemia	31,224
Firearms	28,663
Suicide	468
Combat	462

\* 5K distracted, 1K cell phones, 11K drunk

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# Head Injuries





# Top 10 Driver Distractions and Alcohol-related

1,000 deaths...

1. Using a wireless device, e.g., phone
2. Talking with passengers
3. Reaching for CDs, food, falling objects or other internal distractions
4. Programming radio stations or tinkering with dashboard controls
5. Using an electric razor, applying makeup or other actions related to personal hygiene
6. Unwrapping a burger, opening a canned drink or other movements when eating at the wheel
7. External distractions such as pointing out a billboard or pedestrian
8. Talking or singing to oneself
9. Smoking
10. Daydreaming

**5,000 deaths...**

TTI, 2010



**Plus 11,000 deaths...**

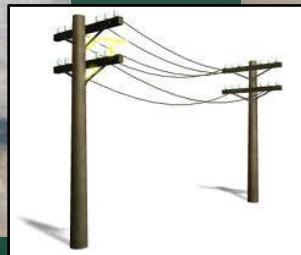


# History

Bell Magneto Wallset 1907



Bell Wall Phone 1956





# Yesterday

**Motorola Dynatac 1983**



**Motorola Droid x 2010**

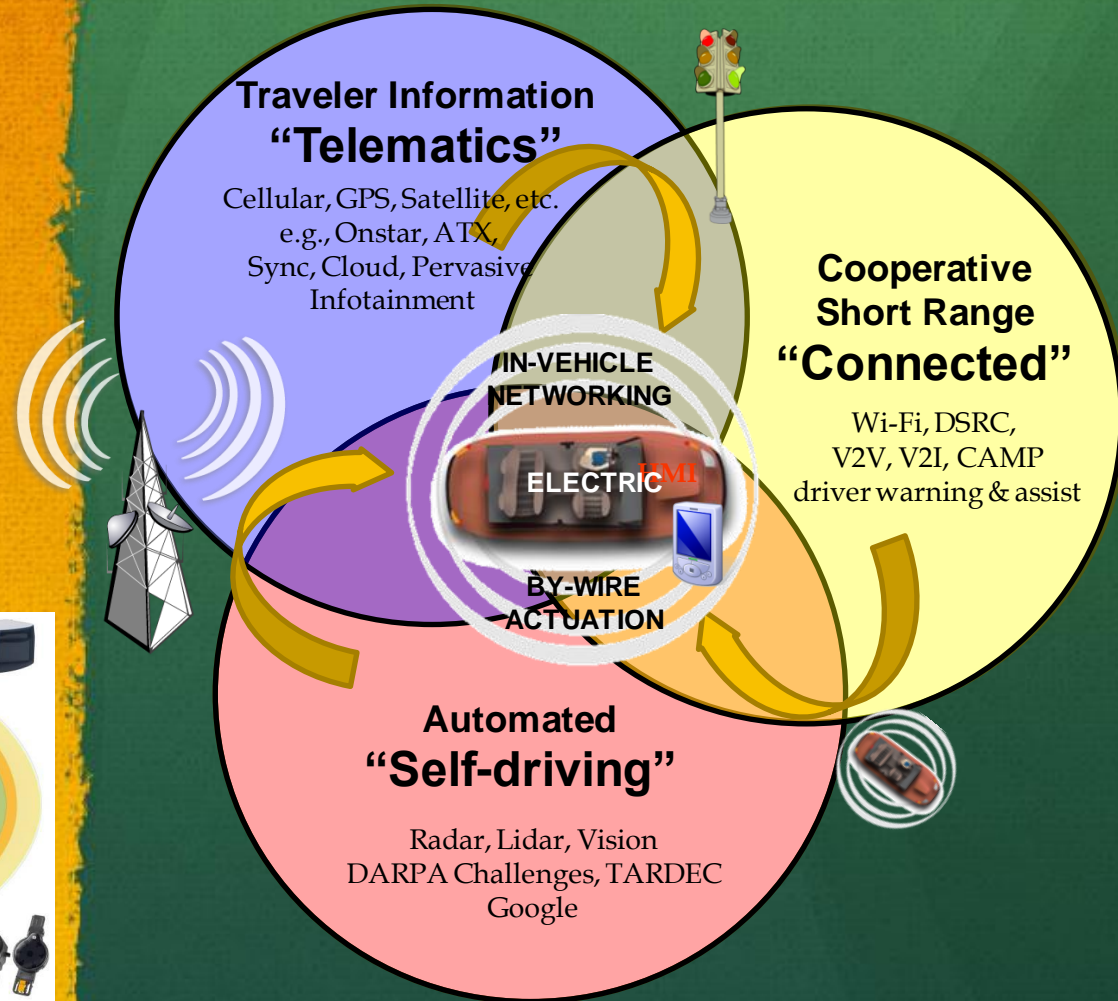
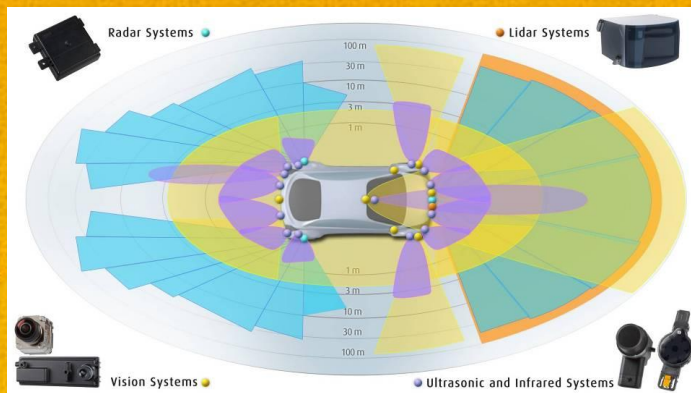


**Smartphone:  
Phone, computer, Internet**



# Half of the Solution: Technology

## Robotics & Communication



# Telematics



- Mayday Emergency Services
- Navigation and Route Guidance
- Stolen Vehicle Location
- Remote Door Unlock
- Remote Vehicle Diagnostics
- Hands-Free Calling
- Roadside Assistance
- Accident Assistance
- Remote Horn and Lights
- Services, E-mail, News, Sports, Stocks, Weather, Traffic
- Infotainment, Satellite Radio
- Wireless phone voice controls
- Streaming audio including Pandora
- Etc.



# Connected Vehicle-to-Infrastructure

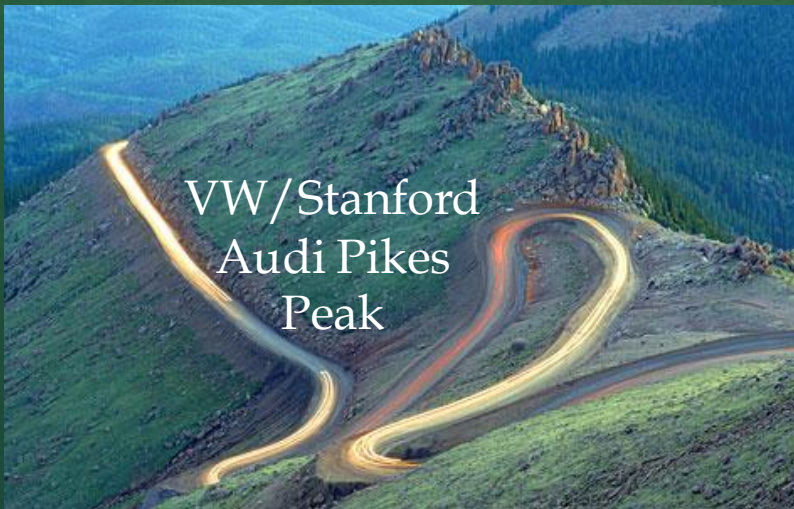


# Connected Vehicle-to-Vehicle

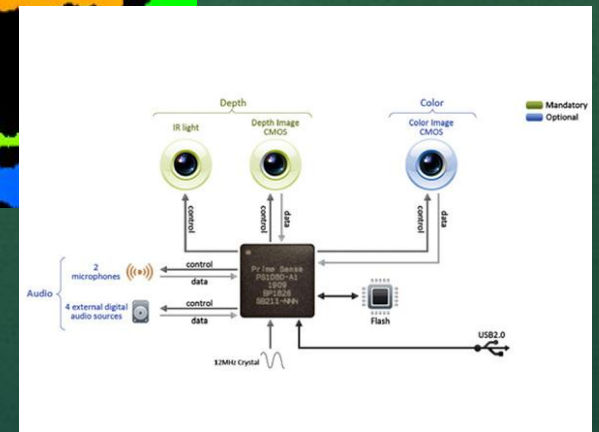
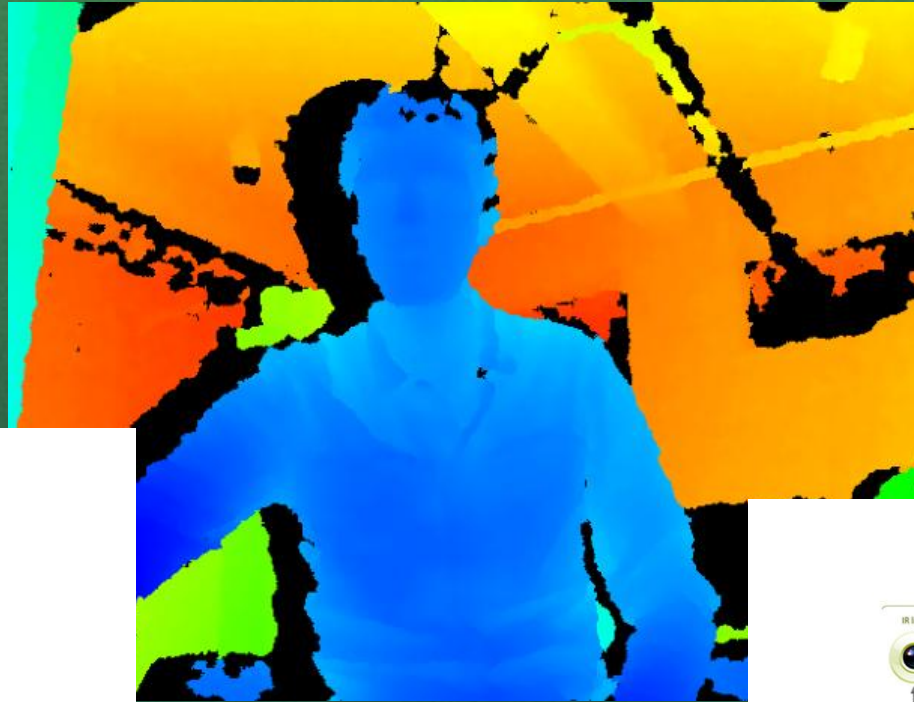




# Self-Driving & Crashless



# XBox Kinect 3D Imaging





# Self-Driving: Safe Point-to-Point

Functionality

## Advanced Driver Assist

Technologies that influence the driver AND act on the vehicle, while maintaining driver-control.

Civilian Examples:

- Lane centering systems
- Pre-crash safety systems
- Driver warning systems

## Semi - Autonomous

Technologies that allow the vehicle to perform autonomously "on demand" in a limited capacity where a driver is ultimately responsible for control of the vehicle.

Civilian Example:

- Autonomous cruise control w/ lane keeping
- Highway On-Demand

Military Example:

- Convoy operations and route clearance performed by AGV's.

## Fully Autonomous

Vehicle drives itself for an entire travel journey.

Civilian Example:

- Vehicle Chauffer
- Autonomous navigation through surface streets, parking lots, urban areas etc.

Military Example:

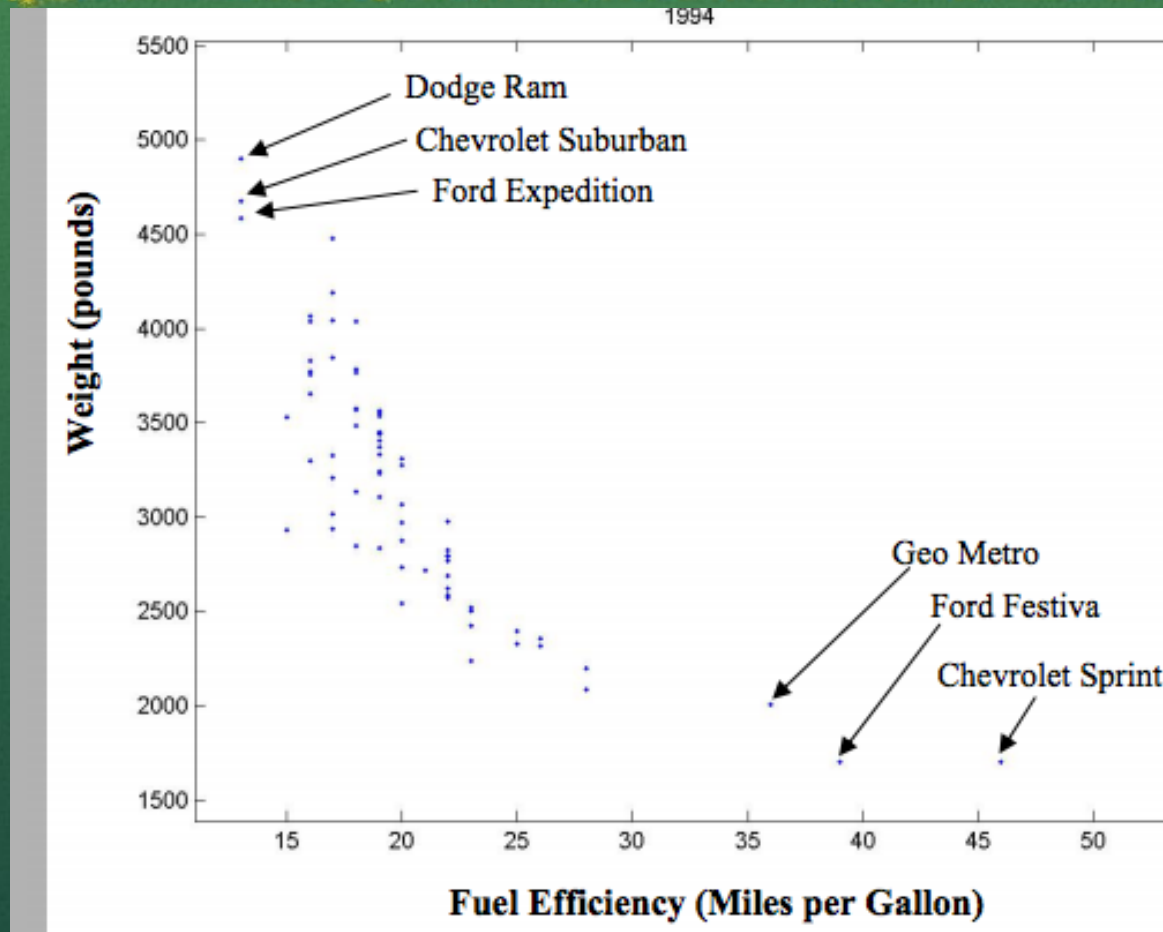
- "Hands off" mission execution in urban operations using Robotic Wingman.

Today

Future

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Self Driving = Light Weight  
Light Weight = More Fuel Efficient





# Personal Urban Mobility



- Point-to-point
- Electric
- Connected
- Self-driving
- Light weight



# Policy: The Other Half

- Transitioning, chicken-and-egg, incompatible
  - Infrastructure: Roadside, legacy
  - Separation of vehicles, lanes, etc.
  - Tradeoffs: Lighter vehicles and safety
- Public or private funding
  - R&D, deployment
  - Infrastructure (taxes, fees)
- Authorization, liability, insurance, etc.
- Public and private roles, incentives, regulatory obstacles, standards
- Testing, evaluation, certification, reliability, maintenance



# Stakeholders Decision Makers Engaged

- HUD/EPA/USDOT livable community partners
- Departments of Defense/Energy and the Joint Base Lewis-McChord sustainability group
- Washington State legislators and agencies (e.g., WSDOT, Commerce, Economic Development,
- Local cities, counties, ports, MPOs
- Auto manufacturers ,telematic and software companies (Inrix, Ford, GM, Microsoft, Cisco)
- Electric power companies and regulators

# Integrated Assessment CVPC & CATES

- Point-to-point
- Electric
- Connected
- Self-driving
- Light weight
- Shared

Roadmap (Expert Backcasts)



Technical Committee Input:  
SAE, AUVSI, TRB, ITSA

Policy Input:  
DOT, DOE, DOD, HUD, MPOs, WSDOT, JBLM

Visions (Expert Forecasts)

Greenfield

Legacy

Babcock  
Ranch

Seattle  
JBLM

US

?

?

Europe

?

?

Asia

2012

2022

2032

- Livable: Local
- Sustainable: International

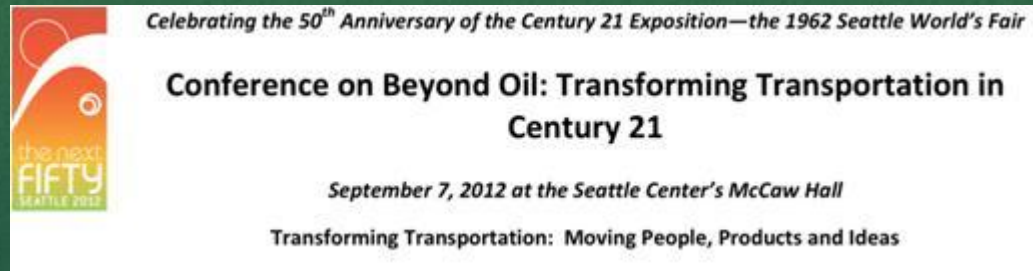
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# Panel Input Planned



Future of Road Vehicle Automation  
Workshop, TRB  
July 25-27, Irvine CA



Autonomous Vehicle Session  
ITS World Congress  
October 22-27, 2012, Vienna Austria

Many others planned!