

# Mobility on Demand & Remotely Operated Vehicles

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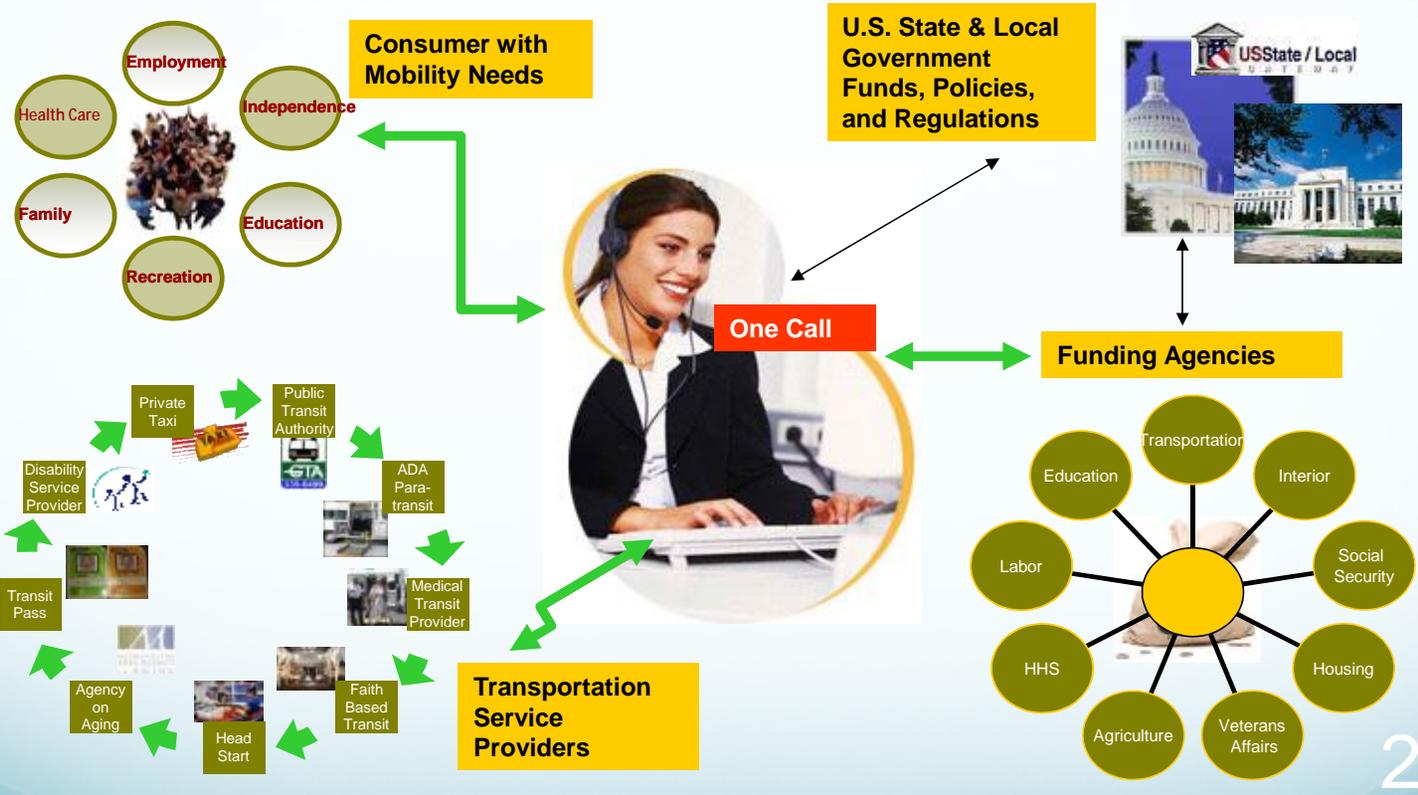
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*Better drivers for a better world.*

# Mobility on demand



Source: Lawrence J. Harman, Geographics Laboratory, Bridgewater State University

# Remote operation of vehicles

**BYD Su Rui goes to market in Beijing, with Remote Driving Control technology**

2012-8-22

Beijing, China – August 21st, 2012

Today, the Remote Driving Control family saloon car by BYD, Su Rui (name for the Chinese market), goes to market in Beijing. Its world-leading Remote Driving Control technology, TID power assembly (turbo charged + direct injection + dual clutch transmission), intelligent devices and exquisite workmanship have become the highlights that attract most attention.



Source: <http://www.byd.com/news/news-117.html> accessed 27 February 2013

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# Qualified remote operators



Source: Hancock Field Air National Guard Base, Syracuse, New York  
Photo by Tech. Sgt. Ricky Best/Released

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## The promises of technology

- mobility for (a) millions of baby boomers who do not want to give up their cars, (b) people legally restricted from driving, and (c) people with disabilities
- transportation on demand that is safe, comfortable, reliable, affordable, and private
- large public benefits by significantly reducing crashes, deaths, and injuries
- merit-based jobs for better drivers
- incentives for millions to improve their driving habits
- client fees that pay for infrastructure
- **achievable in 2020 with remote operation of private vehicles by qualified remote operators that is complementary to autonomous vehicles: the Better-Drivers concept**

# Complementary technologies

## Autonomous

- High speeds
- Long distances
- Separated roadways
- No drivers

## Remotely operated

- Low speeds
- Short distances
- Mixed traffic
- Professional drivers

# Better-Drivers business requirements

## **Technologies**

- High assurance, secure communications with low latency
- Reliable, integrated, interoperable sensing and control platforms
- Robust communication, command, and control pathways and protocols

## **Human resources and market development**

- Risk management integrated with marketing
- Certifiably better drivers recruited, trained, qualified, monitored

## **Legal**

- Law enforcement agreements
- Regulatory acceptance
- Jurisdictional and inter-jurisdictional agreements and contracts

## The technologies are here today

### **AutoPilot: Your car. Our driver. On demand.**

- **Ben Lee**, co-founder and CEO of Autopilot

### **The MV-1 Mobility Vehicle**

- **Ron Stogsdill**, regional sales manager, Vehicle Production Group
- **Rob Taylor**, fleet manager, MV-1 of Arizona, Phoenix

### **Communications & Integration Controls via DSRC and LTE**

- **Barry Einsig**, global transportation executive, Connected Industries Group, Cisco

### **The Cape Cod E-Transit Village Project**

- **Larry Harman**, managing partner, Harman Consulting, LLC, Boston, MA

# AutoPilot: Your car. Our driver. On demand.



The image shows a screenshot of a Facebook page for 'AutoPilot'. At the top, there is a large banner with the text 'AutoPilot: Your car. Our driver. On demand.' and a 'Create Page' button. Below the banner is the AutoPilot logo, which consists of a blue square with a white stylized 'A' inside a circle. To the right of the logo is a smartphone displaying the AutoPilot app interface, which shows a map and a list of nearby drivers with their addresses: '210 E Trade St, Charlotte, NC' and '610 Jetton St, Davidson, NC'. Below the banner and logo, the page name 'AutoPilot' is displayed, along with '121 likes · 2 talking about this'. There are buttons for 'Like', 'Message', and a settings icon. Below this, there is a 'Product/Service' section with the text 'Your Car. Our Driver. On Demand. Request a personal driver with the push of a button!'. To the right of this text is a small photo of a stone monument and a 'Likes' button showing '121'. At the bottom of the page, there is a blue bar with the source information: 'Source: <http://www.facebook.com/myautopilot> accessed 27 February 2013'.

Source: <http://www.facebook.com/myautopilot> accessed 27 February 2013

# The MV-1 Mobility Vehicle



## Made in USA MV1 Mobility Vehicles to Join TAPS Fleet

At a production plant in Indiana, workers are putting the finishing touches on a fleet of fifteen SUV-sized vehicles that will eventually hit the road on the TAPS Public Transit system in North Texas. The MV1, manufactured by **Vehicle Production Group** (VPG) Auto Group, Detroit MI, and marketed by **National Bus Sales** in Fort Worth, TX, is a purpose-built passenger vehicle designed for transport of elderly and disabled riders. The new mobility vehicles are due to arrive in early 2013.

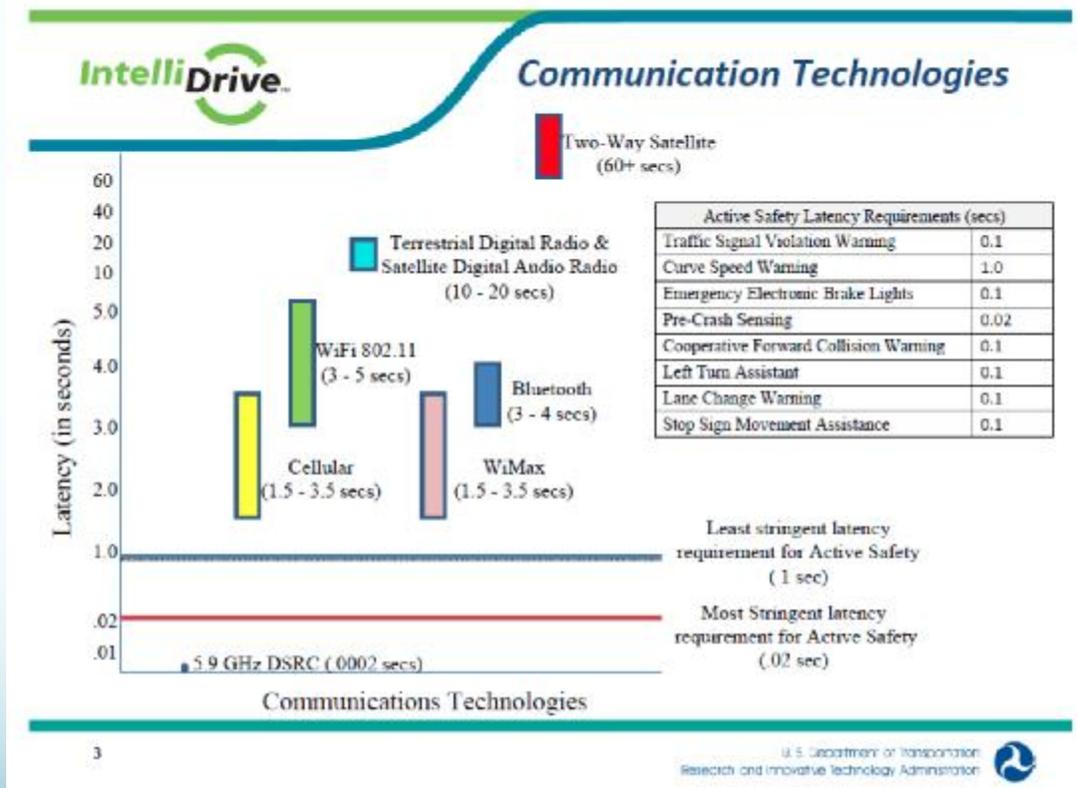
[youtube]http://youtu.be/vB-QV2MpWc[/youtube]

Purchase of the MV1 units from VPG was made possible through a Federal grant. "Department of Transportation provides funding under a 'state of good repair' provision to ensure public transportation fleets are able to meet the needs of their region," said **Brad Underwood**, CEO and Executive Director of TAPS Public Transit.



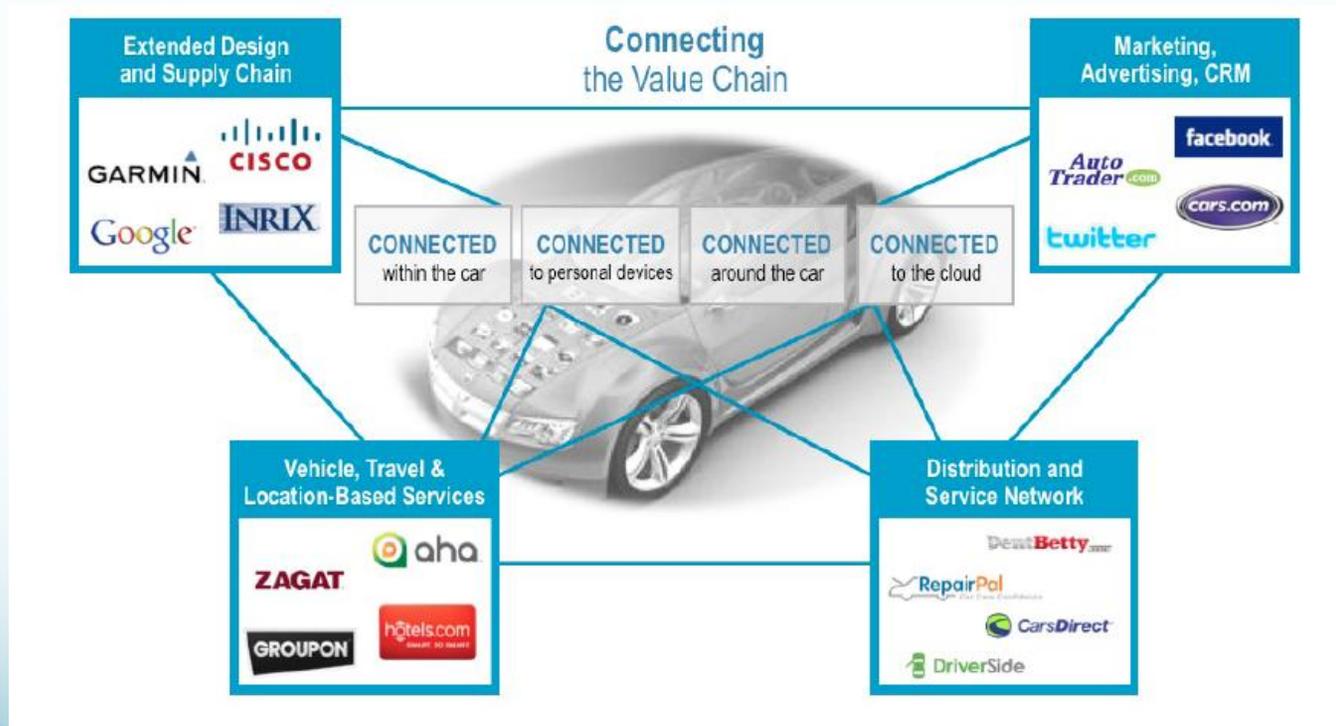
Source: <http://tapsbus.com/mv1-joins-fleet/> accessed 27 February 2013

# Low latency achievable by Dedicated Short Range Communications (DSRC)



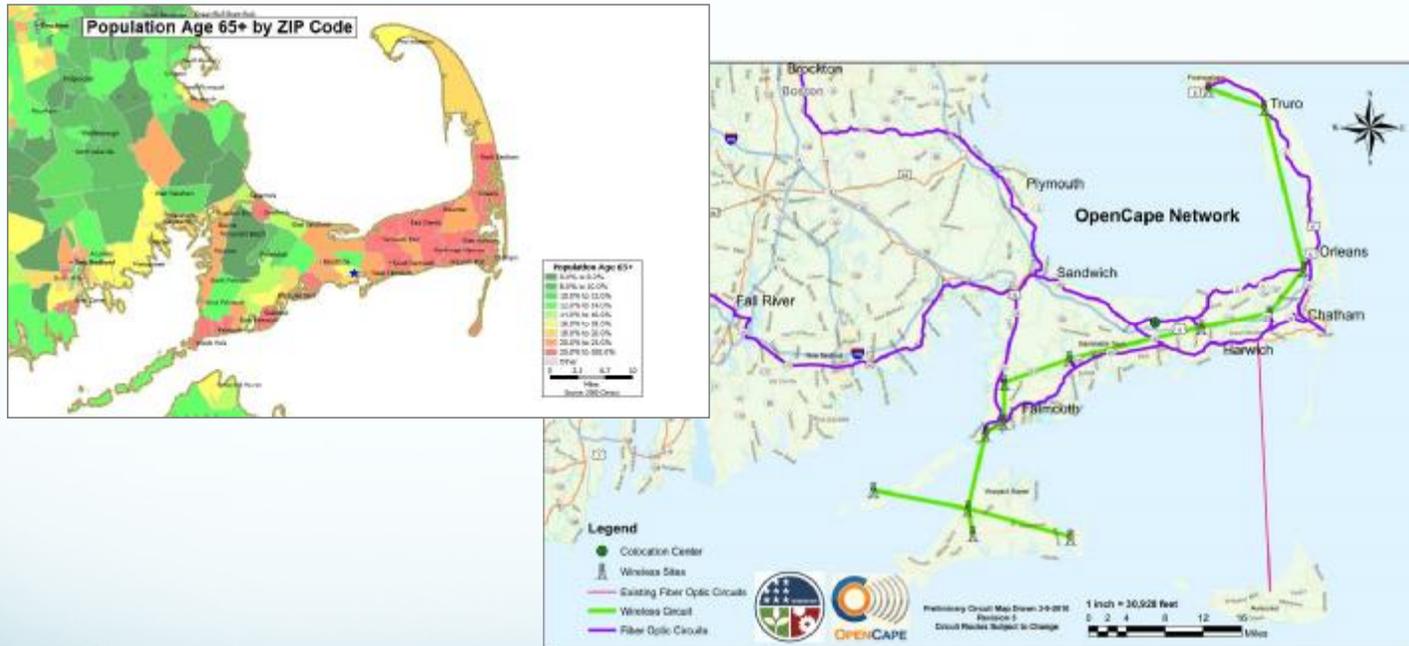
Source: Richard McDonough, Commercial Vehicle Infrastructure Integration (CVII) Program, Connected Vehicle Test Bed Development & Integration Work Shop, June 1, 2012

# Wireless remote operations through Cisco integration



Source: Cisco IBSG, 2011, as shown in "Connected Vehicles: From Building Cars to Selling Personal Travel Time Well-Spent" by Andreas Mai & Dirk Schlesinger

# Cape Cod: robust, reliable, secure communication, command & control

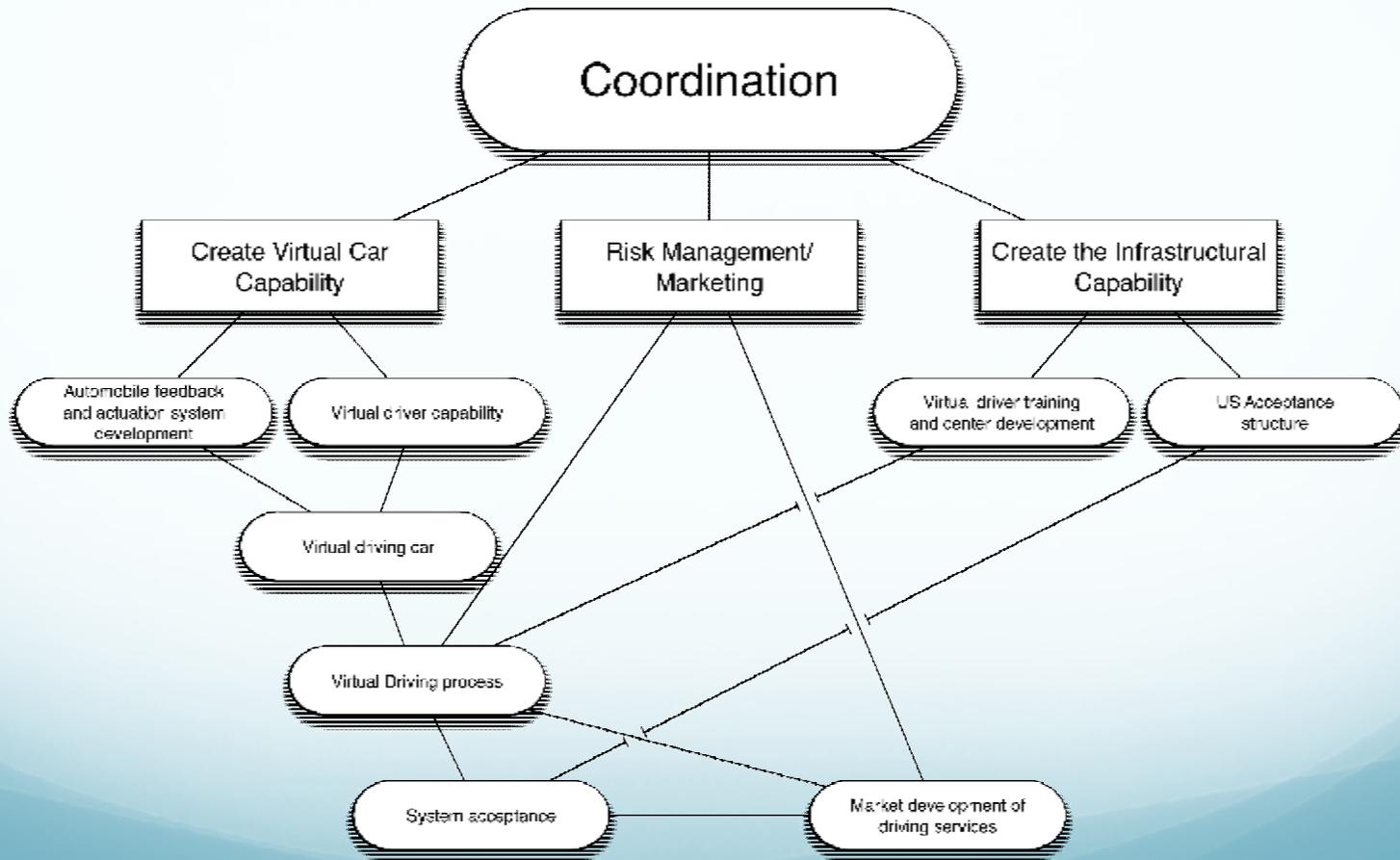


Convergence of OpenCape and Cape Cod Regional Transit Authority (CCRTA) OpenGov Technologies

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Source: Lawrence J. Harman, Geographics Laboratory, Bridgewater State University

# Research will speed deployment



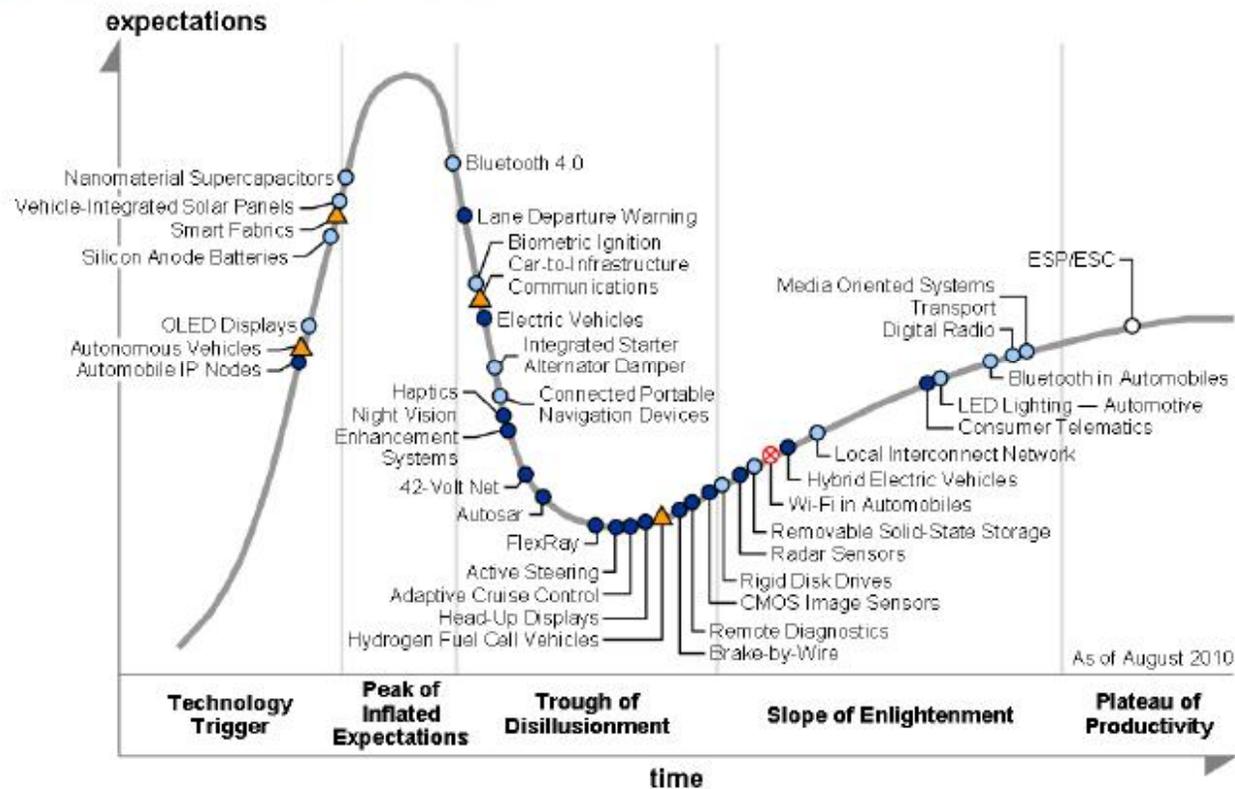
# Conclusions

- The technologies and markets are here now.
- Better-Drivers—remote operation of private vehicles by qualified remote operators—complements autonomous vehicles.
- The Cape Cod demonstration of Better-Drivers is looking for partners.
- Research is needed to realize the potential of technologies that will be ubiquitous in 2020.

# Q & A backup slides

# Technologies will be ubiquitous in 2020

Figure 1. Hype Cycle for Automotive Electronics, 2010



Years to mainstream adoption:

- less than 2 years
- 2 to 5 years
- 5 to 10 years
- ▲ more than 10 years
- ⊗ obsolete before plateau

Source: Gartner (August 2010)

# 2020 Convergence Opportunity

Autonomous Vehicles + Car-to-Infrastructure Communications

= operation of private vehicles by qualified remote operators

| benefit          | years to mainstream adoption |  |  |  |
|------------------|------------------------------|--|--|--|
|                  | less than 2 years            | 2 to 5 years   | 5 to 10 years  | more than 10 years   |
| transformational |                              | Bluetooth 4.0  | CDMA, LTE, DVB Image Sensors   | Autonomous Vehicles<br>Car-to-Infrastructure<br>Communications |
| high             |                              | Integrated Starter/Alternator/Generator<br>LED Lighting — Automotive<br>NAND-based SuperCapacitors<br>Hard-Disk Drives<br>Satellite Antennas/Starlink  | Autonomous Vehicles<br>Wireless<br>Digital Home Telephony<br>Electric Vehicles<br>Hybrid Electric Vehicles<br>Remote Diagnostics   |  |
| moderate         | RFID                         | Biometric Authentication<br>Blind Spot Assist<br>Contextual Displays<br>Navigation Displays<br>Local Interconnected Networks<br>Media Content Systems<br>Transport<br>QLED Displays<br>Removable Solid-State Storage | Active Steering<br>Adaptive Cruise Control<br>Emotion-aware<br>Parking<br>HUDs<br>Head-Up Displays<br>Lane-Departure Warning<br>Rear-View Camera Management Systems<br>Radar Sensors | Hydrogen Fuel Cell Vehicles<br>Smart Fabrics                   |
| low              |                              | Digital Radio<br>Vehicle-Integrated Color Panels   |  |  |

As of August 2013

Source: Gartner (August 2010)

Remote  
Operation  
of Vehicles

# Better-Drivers complements autonomous vehicles

- Services provided under the Better-Drivers model could rely on autonomous technologies 1 percent to 99 percent of the time.
- Islands of Better-Drivers services can provide first-mile connectivity to the limited-access roads suitable for autonomous vehicle operations.
- No changes in current laws or risk management are required.\*

\* Pre-competitive research is needed to preserve this situation and allow the private sector to innovate.

# Solution uses existing, familiar interfaces and business models

- All current driver for hire models apply (cab, car service, jitney, fleet) with existing care, custody, and control contracting
- Business models, visuals, concepts of operations are extensions of the present and therefore readily understood by the public and by regulators
- Clients can hire the safest drivers in the world (actuarially proven and with fitness for duty testing) and support good jobs in economically depressed areas
- Incremental rollout from controlled environments to open roads: car wash, valet parking, oil change drop-off, private parking lot; low speed on private campus; jitney, taxi, limousine, paratransit; drive your parents

# Insurance companies and alcohol-impaired drivers are a large, early market



Table 3  
Total and Alcohol-Impaired Driving Fatalities\*

|  | 2008   | 2009   | Change | % Change |
|--|--------|--------|--------|----------|
| Total Fatalities   | 37,423 | 33,808 | -3,615 | -9.7%    |
| AI Driving Fatalities  | 11,711 | 10,839 | -872   | -7.4%    |
| <b>Alcohol-Impaired Drivers in Fatal Crashes by Vehicle Type</b> |        |        |        |          |
| Passenger Car  | 4,679  | 4,242  | -437   | -9.3%    |
| Light Truck - Van  | 337    | 296    | -41    | -12%     |
| Light Truck - SUV  | 1,651  | 1,576  | -75    | -4.5%    |
| Light Truck - Pickup   | 2,316  | 2,260  | -56    | -2.4%    |
| Motorcycles  | 1,561  | 1,314  | -247   | -16%     |
| Large Trucks   | 63     | 54     | -9     | -14%     |

Source: FARS 2008 (Final), 2009 (ARF)  
\* See definition in text.

U.S. PUBLIC IN FAVOR OF USING ADVANCED TECHNOLOGY TO STOP DRUNK DRIVERS FROM OPERATING THEIR VEHICLES--A new survey sponsored by the Insurance Institute for Highway Safety (IIHS) indicates that two of three respondents think that using advanced technology to stop drunk drivers from operating their vehicles is a good or very good idea, assuming the technology is reliable. More than 40% said they would want such devices on their own cars if offered the option.

*ICADTS Reporter* Vol. 21, Number 2, Spring 2010, ISSN 1016-0477

## Connect rich markets with available labor

- Within United States
- Within India
- Within European Union
- Within China



# Training and remote driving through FAAC simulator station



Source: David Bouwkamp, FAAC Incorporated

## Enhances brands offering automotive internet solutions

- Creates larger market for automobiles
- Enhances leadership position of automobile manufacturers offering secure communications, command, and control independent of whether the services are delivered as envisioned
- Accelerates original equipment manufacturer purchase of automotive internet solutions

## Provides market efficiency for riders and ride providers

- Makes taxicab-style services available everywhere there are automobiles, increasing personal mobility options
- Allows car owners to manage car use and ride sharing in a manner similar to managing their calling circles or social networks
- Consumers are willing to pay a premium for short-distance rides with trusted, vetted drivers. This will make it worthwhile to be certified by competent, independent third parties (e.g., unions, insurance safety organizations, civil rights groups)

## Local services can be modeled after cable television franchises

- Optional services do not displace current services
- Franchise fees to local government pay for needed infrastructure, oversight, and law enforcement
- As with local cable access channels, franchise agreement can require a number or percentage of service hours to be provided as public transportation
- No government subsidy required
- Creates good jobs for sales, drivers, and supervisors

# Proof of Concept

- Modified Turing Test
  - Is the driver live (in the car) or remote?
  - Can a passenger tell whether the driver is in the car?
- Interaction is with a live vehicle operator—in person or remotely located—via a monitor on the privacy screen
- Driving can be with any level of technology assistance; near term testing could require driver in car; eventually, driver will be remotely located and use remote controls and communications in combination with technology assistance

# New equipment and services

- Opportunity to sell cars to non-drivers
  - More than 100 million in U.S.
  - Better-Drivers-capable vehicles will have sensor packages
  - Controls and feedback systems potentially available in car package that can be used to control paired vehicle
- Premium taxicab/black car service in your own car
  - Drivers centrally recruited, hired, trained, dispatched, and monitored will reduce crashes 40%
  - Drive yourself one-way, use service to ride home
  - Virtual Co-Pilot option akin to assisted living
  - Potential for franchise model
- Jobs, jobs, jobs—good jobs!
  - Drivers, supervisors, dispatchers; sales; trainers; certification test developers and administrators

# Drivers can be recruited and trained through online games

- Teenagers average 10,000 hours online by age 18
- Online games and simulations can be used to identify and reward better driving habits
- Instrumented vehicles could be similarly monitored in voluntary program
- Optimal cognitive loads and information provided could be experimentally derived
- Arcade type driving simulators could be developed into remote control driving platforms

# Save lives, money, and time

- Reducing crashes by 10%, 20%, let alone 40%, reduces both societal and personal costs by reducing
  - Deaths
  - Injuries
  - Property damage
  - Delay
  - Insurance
- Dollars saved accrue to the following entities:
  - Insurance companies—can reduce premiums slower than accidents are reduced, so profits grow
  - Drivers can receive reduced premiums by accepting service
  - Fewer deaths and injuries reduces burdens on medical system, government coverage of uninsured
  - Fewer days of lost productivity
  - Cab driver productivity increases by eliminating deadheads

# Occupants and Nonoccupants Killed in Traffic Crashes (United States)

Figure 1  
Fatalities and Fatality Rate per 100M VMT by Year



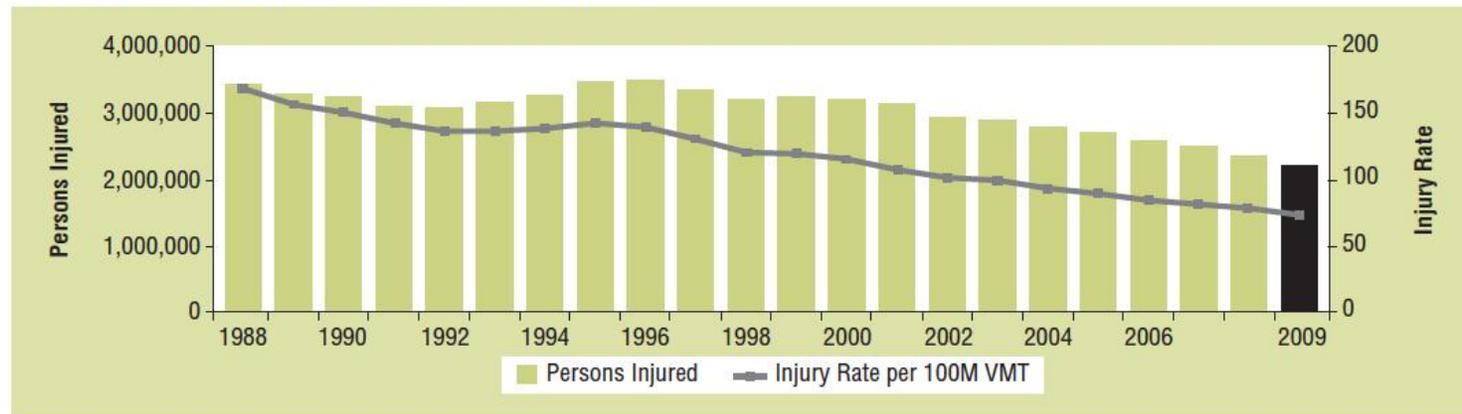
1950-1974: National Center for Health Statistics, HEW, and State Accident Summaries (Adjusted to 30-Day Traffic Deaths by NHTSA); FARS 1975-2008 (Final), 2009 Annual Report File (ARF); Vehicle Miles Traveled (VMT): Federal Highway Administration.

2008 passenger vehicle deaths: 25,462

2009 passenger vehicle deaths: 23,382

# Occupants and Nonoccupants Injured in Traffic Crashes (United States)

Figure 2  
**People Injured and Injury Rate per 100M VMT by Year**



2008 people injured in motor vehicle crashes: 2.35 million

2009 people injured in motor vehicle crashes: 2.22 million