Automated Driving: It It Real This Time?

Presentation to NRC Committee on
Autonomy Research for Civil Aviation

Richard Bishop, Bishop Consulting

August 28, 2013

Roadmap

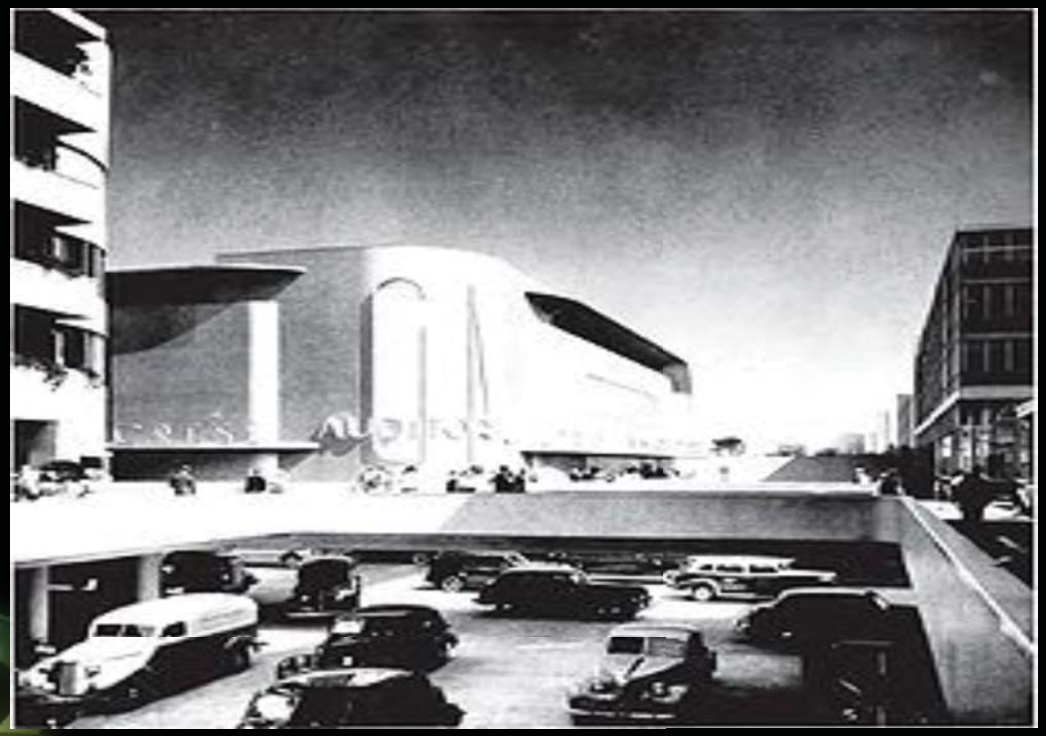
- Automated driving is here.
- After decades of false starts, why now?
- What makes it real?
- What if it all goes wrong?
- How is government active?
- Bringing It All Together

Road Travel: *The Ultimate Vision*

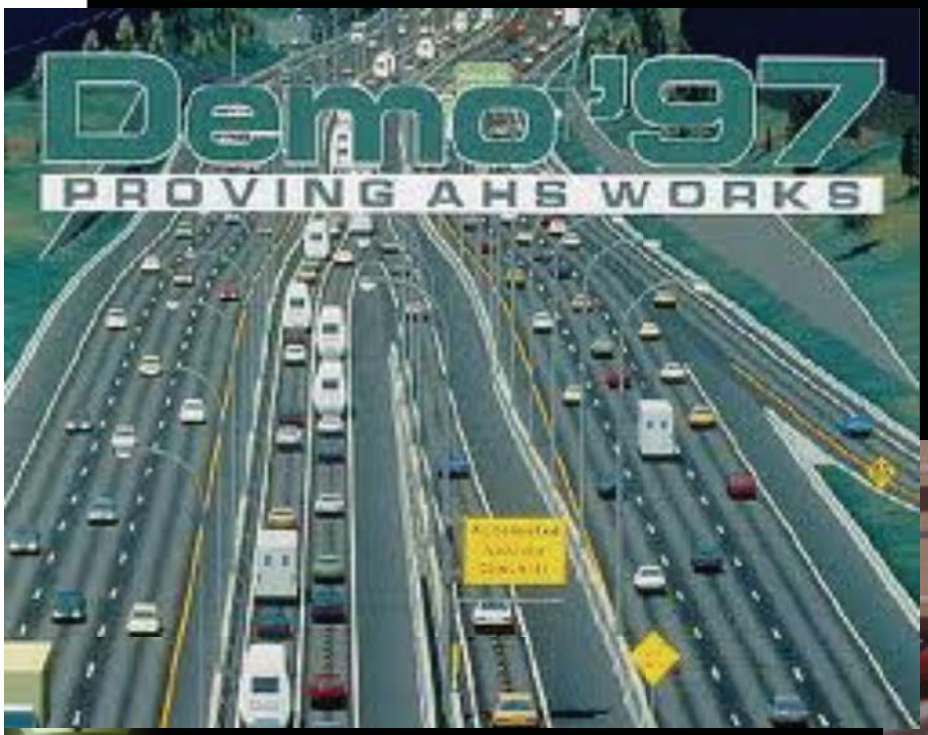
- Safe
- Smooth
- Uninterrupted
- Expeditious
- Restful / entertaining
- Productive time
- Affordable
- Connected and aware
- Good for me, good for society
- ***Trustworthy***

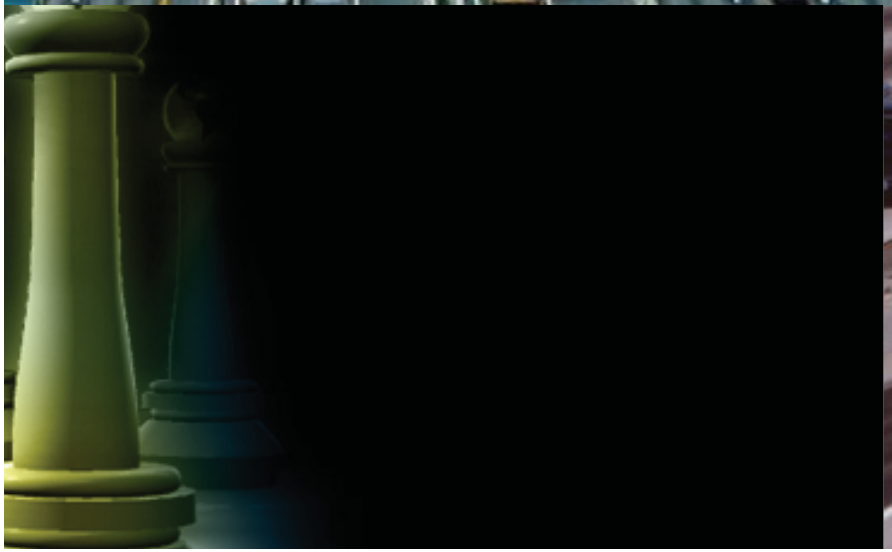
The Automation Wave is Upon Us

Decades of bold initiatives

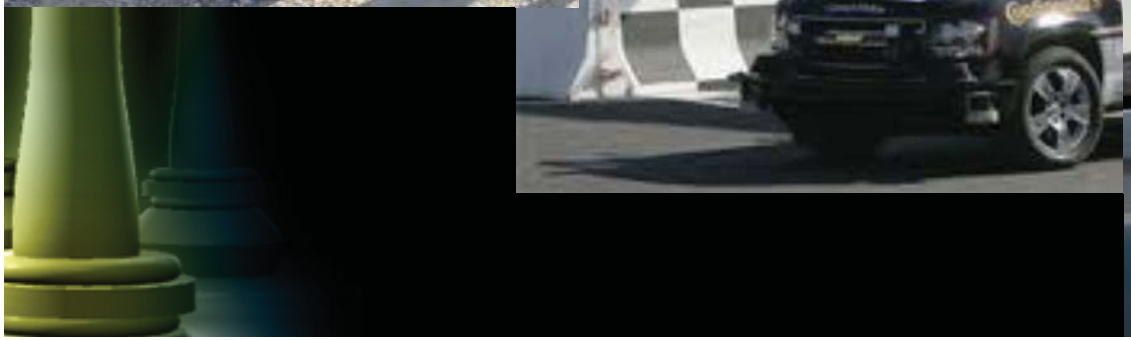


Decades of bold initiatives





Decades of bold initiatives – last decade

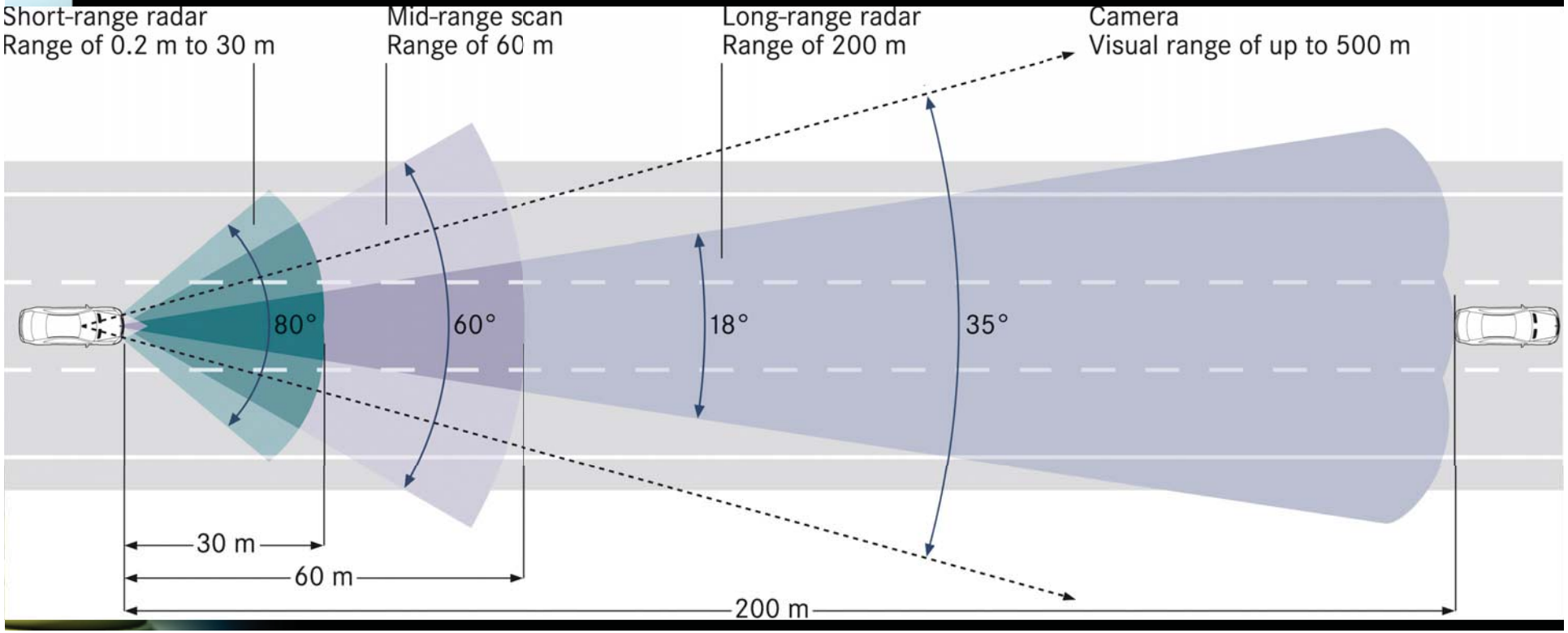


What Held Automation Back?

- Processing speed / power
- Cost
- Packaging
- Vehicle / Highway Intelligence
- Deployment Investment

Today: Driver Assistance Systems Have Matured

- Crash Warning / Prevention
- 360 degree monitoring/warn/assist systems



Active Safety = Crashes Avoided

- Traffic-Adaptive Cruise Control
- Electronic Stability Control
- Forward collisions
- Lane Centering
- Lane departure
- Blind spot
- Pedestrians
- Fatigue
- Night Vision
- Speed Sign Recognition

Inflection Point

- Suppliers selling millions of units per year.
- Active safety systems offered on dozens of car models.
- Volvo Cars: *1 million auto-braking cars sold*

What's Available on a $30,000 Car?

- Adaptive cruise control
- Forward Collision Mitigation
- Blind spot information system
- Traffic sign recognition
- Lane keeping aid
- Driver alert

Ford Focus

"The Thinking Car"
One hour TV documentary

streaming at
www.snagfilms.com

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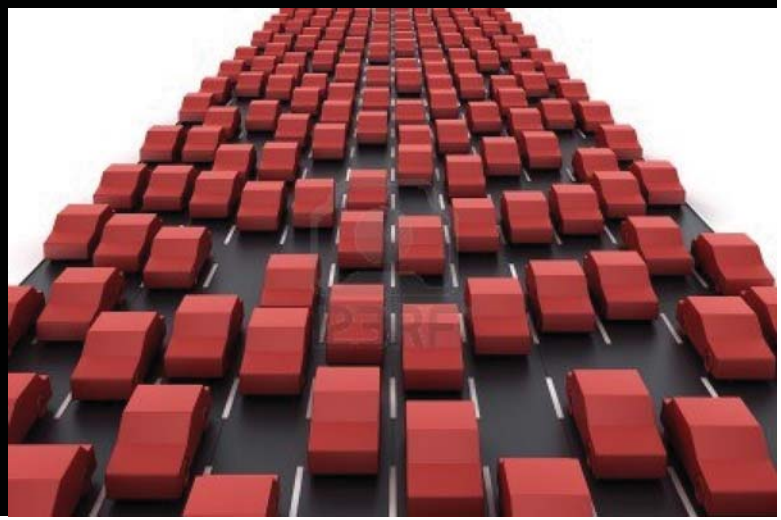
Is Automated Driving “Real” This Time?

- Or is it all hype?
- Barriers of the past have been largely overcome.
  - ✓ Processing speed / power
  - ✓ Cost
  - ✓ Packaging
  - ✓ Vehicle intelligence alone sufficient
  - ✓ Deployment investment? Not needed.



Automated Driving Starts on the *Highway*

- Traffic Jam Assist
  - Mercedes, BMW *launching this year*
  - Volvo, Audi, others to follow quickly
- Highway Pilot
  - Mercedes, GM, BMW very active
- Pacing factor: role of the driver

Mercedes 2014 S-Class

- traffic jam assistant with ACC and Heading Control for low speed traffic
- limited hands-off-allowance
  - prototype requires driver engagement every 8 seconds
- Highway speed lateral assist

Upcoming Demonstrations

NISSAN

USA – Now

Tokyo -- October

Videos

- Nissan Autonomous Drive
  - http://nissannews.com/en-US/nissan/usa/
- Audi Traffic Jam Assist
  - http://www.youtube.com/watch?v=JnPJse5yYbc
- BMW Highly Automated Driving
  - http://www.youtube.com/watch?v=DgIAs3sBxCQ
- Audi Valet Parking
  - http://www.youtube.com/watch?v=rgN8MOrss40&list=TLJoBL8F6vrjg

Rollout Timing: Highway Driving

- 2014 - 2016:
  - Combined lateral and longitudinal control
  - Slow speeds initially …evolving to full highway speeds
  - Driver monitors system
  - *Driver prepared to take over at any moment*
- 2018 - 2020:
  - Highly automated driving at highway speeds
  - Active monitoring of the system not required
  - *Driver prepared to take over with some lead time.*
- 2025:
  - Fully automated driving
  - Monitoring of the system is not required
  - *Driver does not need to take over driving at any time.*

Rollout Timing: *Street Driving*

- Urban driving presents very complex situations
  - Extremely challenging
  - U. Parma
    - http://www.youtube.com/watch?v=PLaT5kudGrA
- 2030 or later
  - Early systems in protected environments could come much sooner
- Transit implications
- Parking implications

U. Braunschweig:
Urban Automated Driving

Google?

- Major step by Google will stimulate the market…
- …. but the big volumes will stay with car-makers.

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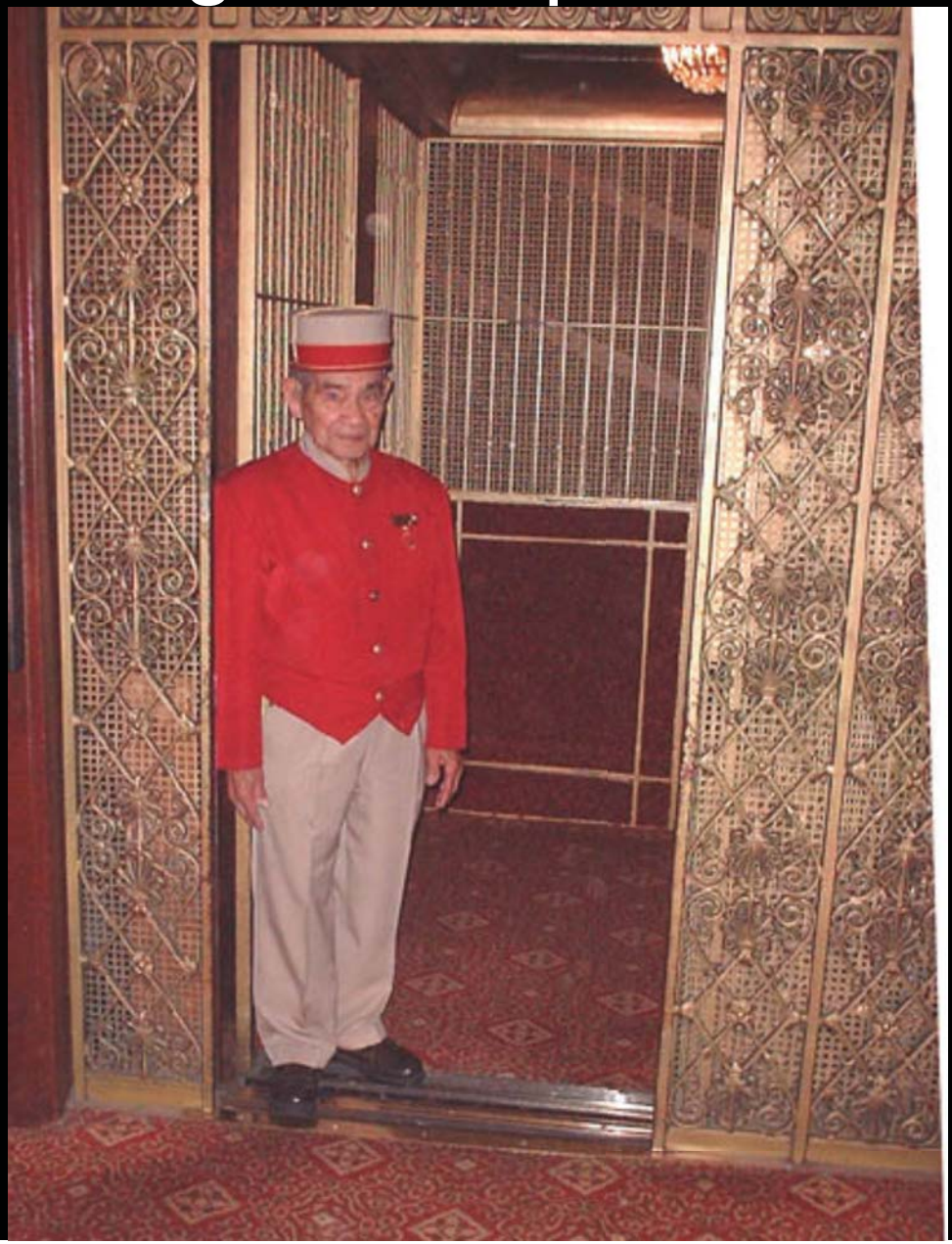
How to gain the public's trust?



Challenges

- Liability
- Test and evaluation
- Regulation
- Privacy?
- Connectivity?
- Cybersecurity?
- Government, industry, and interest groups are working together.

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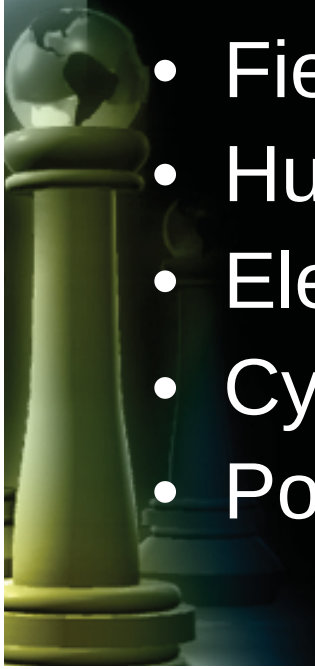
US Department of Transportation

- Intelligent Transportation Systems Joint Program Office
  - Automation Strategic Plan being published this Fall
- Federal Highway Administration
  - Exploring “High Performance Vehicle Streams”
  - Based on automation and connectivity
- National Highway Traffic Safety Administration
  - Ongoing human factors research for automated driving
  - Team members include GM, Google
  - More work planned

NHTSA: Key Issues

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

- Understanding benefits / disbenefits
- Performance Requirements
- Objective testing
- Certification for public use
- Field studies
- Human factors
- Electronics reliability
- Cybersecurity
- Policy / legal aspects



NHTSA Policy Document

- NHTSA Preliminary Statement of Policy Concerning Automated Vehicles (May 30)
  - Levels of Automation
  - Guidance to States
  - Research Roadmap

- http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development

New European Work: Highway Driving

- **AdaptIVe: Automated Driving Applications and Technologies for Intelligent Vehicles**
  - €25M budget
  - start January 2014
  - supervised automated driving
  - 10 car-makers, led by Volkswagen
- **RESPONSE4:** Code of Practice (COP) for Highly and Fully Automated Driving
  - Addressing regulatory changes to allow market introduction

Automation Projects: Asia

- Japan
  - Ministry of Economy, Trade, and Industry
    - Energy ITS: truck platooning for reduction of fuel / emissions
  - Ministry of Land, Infrastructure, and Transport
    - New program to be announced in October
- China
  - Limited activity
- Korea
  - Limited activity

Research Trends Globally

- USA
  - NHTSA initiating new program
- Europe
  - New round of major funding starting now
  - Further funding ramping up ~2015
- Asia
  - Japan: continuing and new work
  - China, Korea activity not significant

Private sector investment dwarfs public sector!

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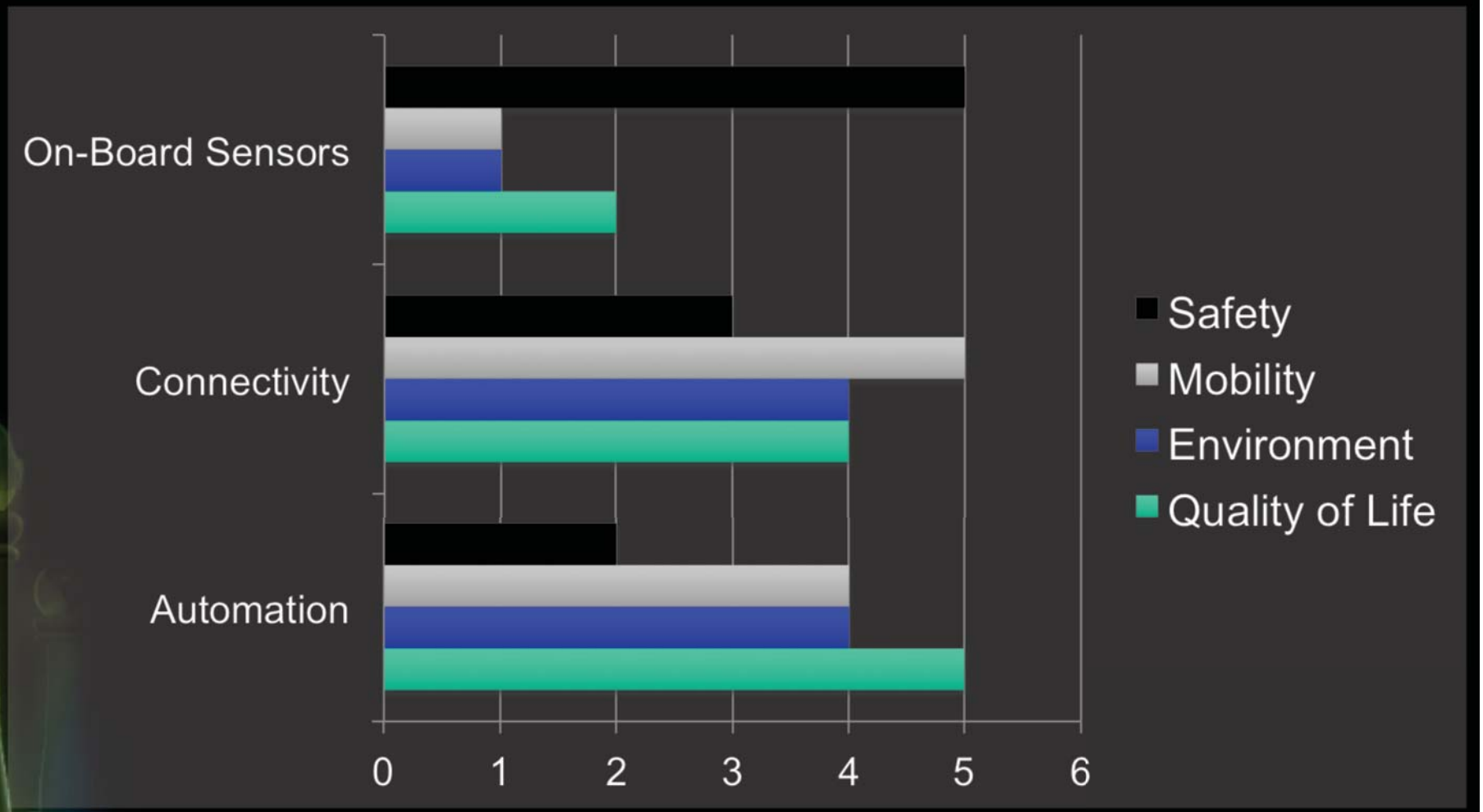
Mapping to Transportation Objectives



Key Research Questions

- TRB Joint Committee on Road Vehicle Automation
- Summer workshop July 2013 at Stanford
- www.vehicleautomation.org

TRB Joint Committee on Road Vehicle Automation: Breakout Groups for Research Q's

- Automated commercial vehicle operations
- Cybersecurity and resiliency
- Data ownership, access, protection, and discovery
- Energy and environment
- Human factors and human-machine interaction
- Infrastructure and operations
- Liability, risk, and insurance
- Shared mobility and transit
- Testing, certification, and licensing
- V2X communication and architecture

Thank You

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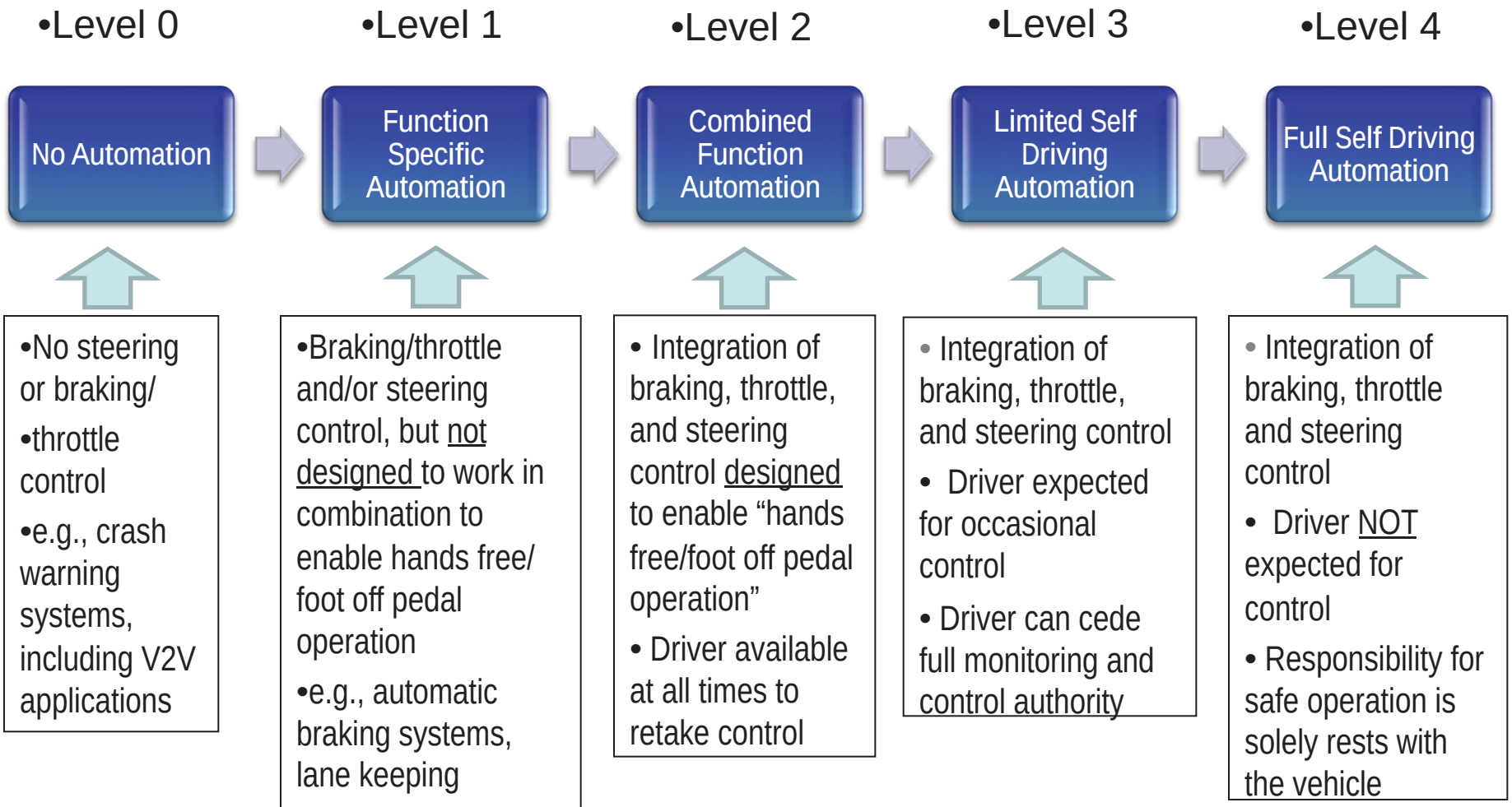
Nissan Autonomous Drive

BACKUP SLIDES

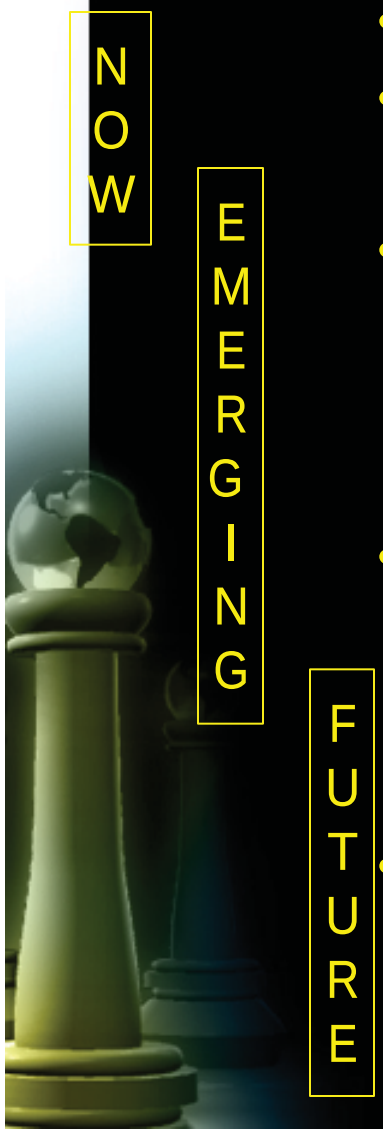
Conceptual Framework - Levels of Automated Driving (Draft)



Levels of Automation

- Level 0 -- No Automation: Human driver executes manual driving task
- Level 1 -- Function-Specific Automation: The driver permanently controls either longitudinal or lateral control. The other tasks can be automated to a certain extent by the assistance system.
- Level 2 – Combined Function Automation: The system takes over longitudinal and lateral control, the driver shall permanently monitor the system and shall be prepared to take over control at any time.
- Level 3 – Limited Self-Driving Automation: The system takes over longitudinal and lateral control; the driver must no longer permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.
- Level 4 -- Full Self-Driving Automation: The system takes over longitudinal and lateral control completely and permanently. In case of a take-over request that is not carried out, the system will return to the minimal risk condition by itself.

Levels of Automation



- Level 0: No Automation
- Level 1: Function-Specific Automation
  - either longitudinal or lateral control
- Level 2: Combined Function Automation
  - longitudinal and lateral control
  - driver is monitor
  - ready to take over control
- Level 3: Limited Self-Driving Automation:
  - longitudinal and lateral control
  - driver need not monitor the system
  - driver must take-over control within a time buffer
- Level 4: Full Self-Driving Automation:
  - system takes over control completely and permanently
  - if needed, system attains minimal risk condition automatically

Automated Driving and The Law

- USA
  - Everything is permitted unless prohibited
  - Several states have authorized automated driving for testing
  - Government guidelines more likely than regulations
- Europe
  - Vienna Convention of 1968 may need changes to enable automation
- Manufacturer Liability
  - For automakers, lawsuits are a given
  - Introduction of any new safety technology a business calculation
  - Automation forces development of new test and evaluation procedures

Other Work in U.S.:
FHWA/PATH Truck Platoon Tests (2010)

Fuel economy improvements:
4-18%

6 m gaps

Other Work in U.S.: ARMY AMAS

- Autonomous Mobility Appliqué System (retrofit)
- Aim
  - Better surveillance for threats
  - Less stress, fatigue for soldiers
  - Less personnel exposure to threats
  - Increase soldier protection from road crashes
- Two year demonstration program begins this summer
- Army moving into production?
  - active safety (commercial systems)
  - truck convoying / autonomous capability