CLEMSON UNIVERSITY INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH

# *The Growing Role of Electronics in Automobiles*

## *A Timeline of Electronics in Cars*

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by

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# *Introduction to Clemson University*

- A Land-grant University Founded in 1889
  - Focus on Agriculture and Engineering
  - Tradition of Economic Transformation in Agriculture, Textiles, Ceramics, Chemicals
- Technically Oriented Public Research University
  - 17,000 Graduate and Undergraduate Students
  - $220 Million in Research Expenditures
  - Strength in Engineering, Architecture, Agriculture, Entrepreneurship and Communication

# *Unparalleled Access to the Market Place*

**More than 1,000 automotive assemblers and suppliers within a day's drive of Greenville**

# *CU – ICAR Campus*

# *Major Systems*

FEV Engine Dynamometer

MTS Road Simulator
in Weiss
Environmental Chamber

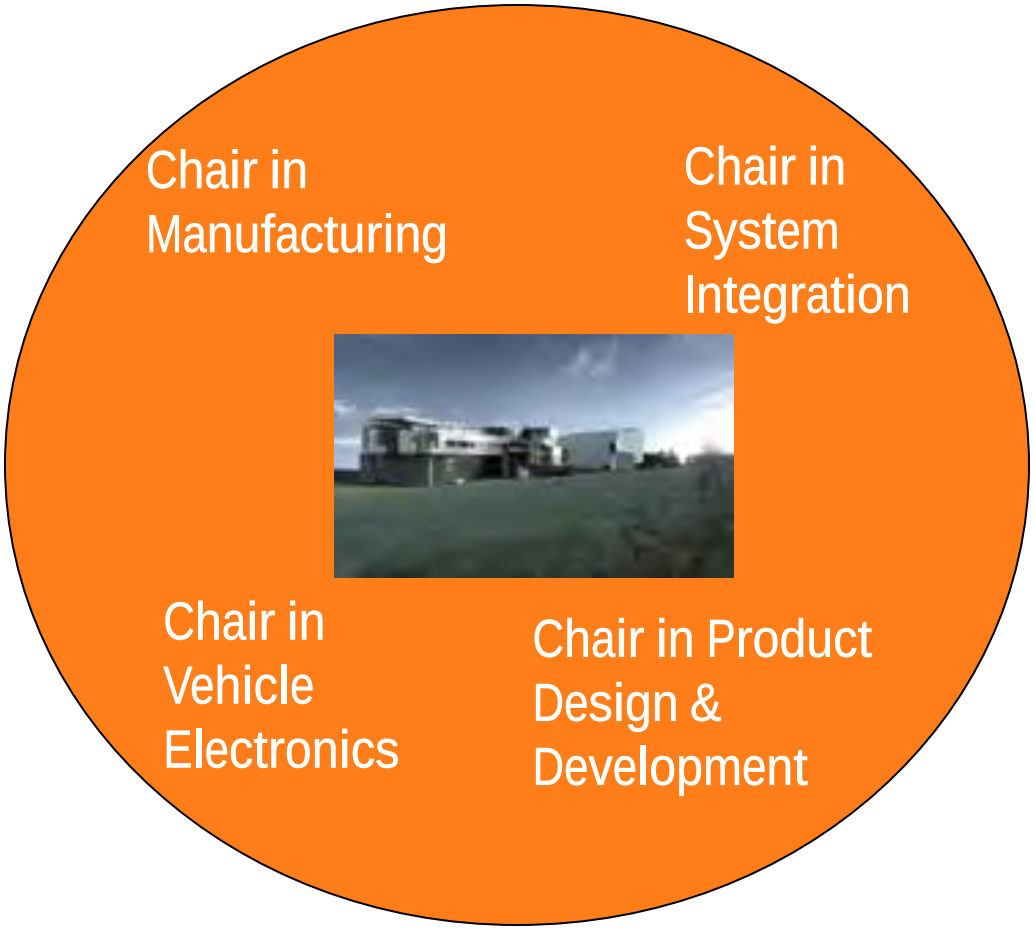
4-Wheel Chassis Dynamometer
in Anechoic Chamber

Zeiss Full Vehicle CMM

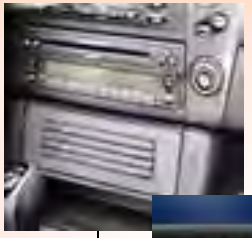
ETS-Lindgren EMC Chamber

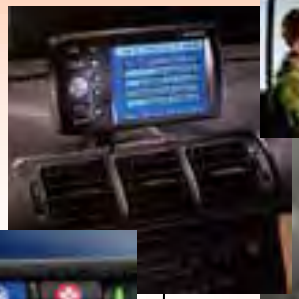
# *The Impact*

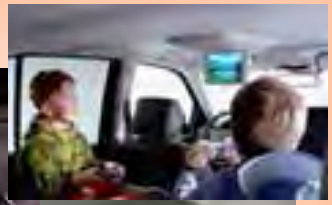
- Emissions
- Safety
- Energy
- Manufacturing

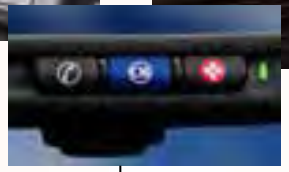


# *History of Car Media – It is Accelerating!*







1930s
commercial introduction of the fitted car radio came in the from the Galvin Manuf. Corporation.

1952
Blaupunkt became the first maker to offer FM receivers

1965
Ford Motor Company introduced dealer-installed 8-track players as an option on most models

1970's
Compact Cassette Wins the war with 8 track for automobiles

1990's
Compact Disk Wins the war with tapes for automobiles

1996
GM offers Emergency services and system monitoring

1997
Mercedes offers GPS

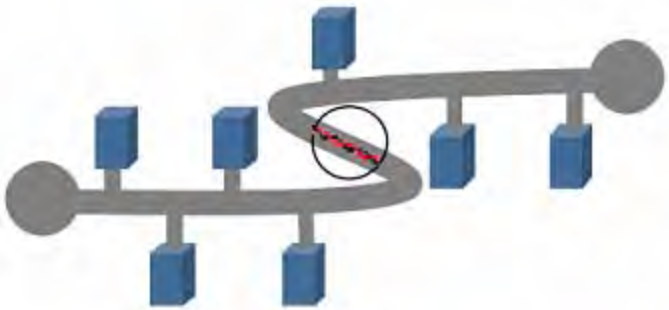
2002
Honda Odyssey factory installed DVD player

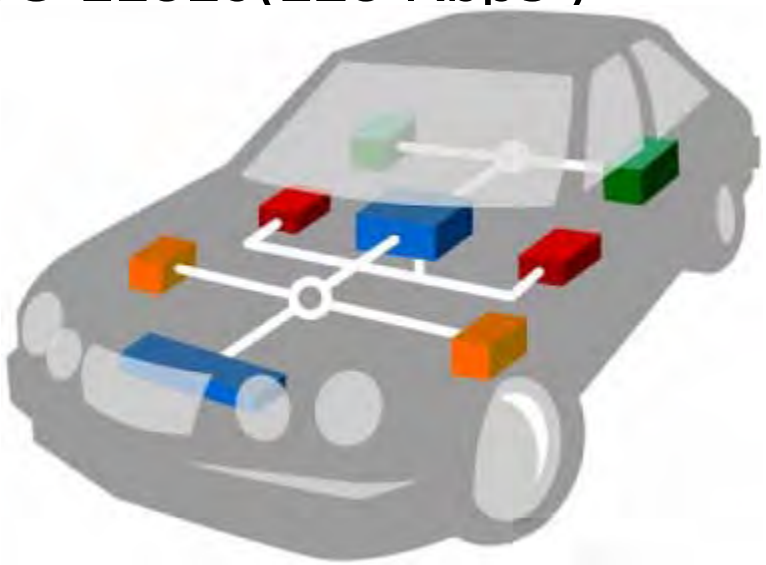
2003
Manufacturers offer a car radio capable of CD, MP3, XM satellite radio and AM/FM playback

What Next?

# CAN Introduction

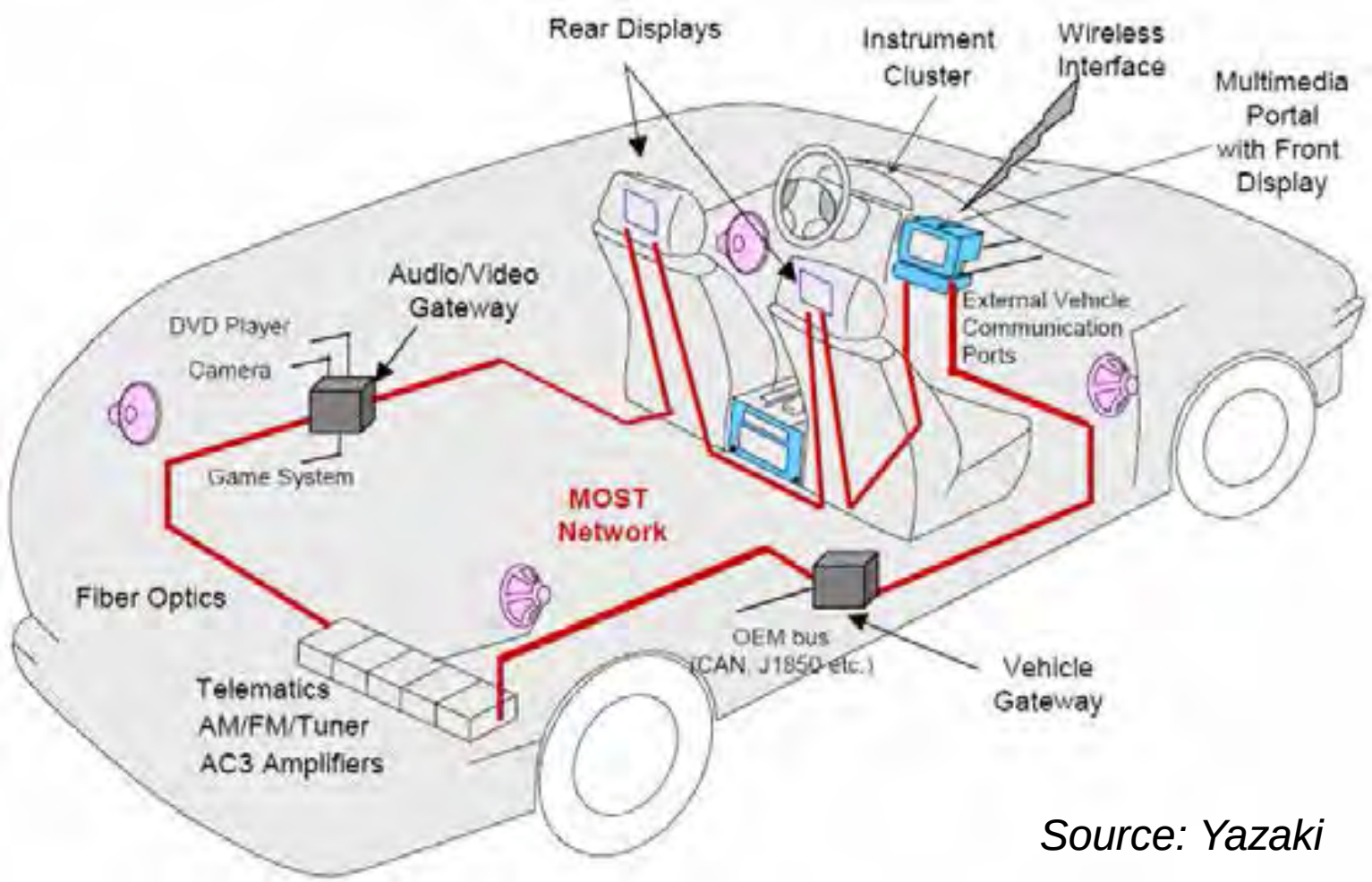
- Controller Area Network, introduced by Bosch,1986
- Serial bus for distributed control system
- Twisted-pair media used with bandwidth up to1 Mbps and 40 devices.
- ISO 11898 (1 Mbps) and ISO 11519(125 Kbps )





*Source: Xilinx*

# MOST Topology




*Source: Yazaki*

# *Automobiles are Complex Electronic Systems*

Functions typically controlled electronically include:

- Engine ignition (spark, timing)
- Fuel injection
- Emissions controls
- Collision avoidance systems
- Heating/air conditioning
- Navigation systems
- Suspension systems
- Transmission controls
- Lights, horn, wipers, defrosters …
- Entertainment systems
- Braking (anti-lock brakes)
- Steering (steering assist, 4-wheel steering)
- Seat & pedal positions
- Communication systems
- Safety systems
- Noise cancellation
- Security systems

- Current automobile designs have nearly 100 microprocessors
- Number of processors expected to double in 5 years.
- A typical automobile contains about 5 miles of wiring.

It is all about systems integration

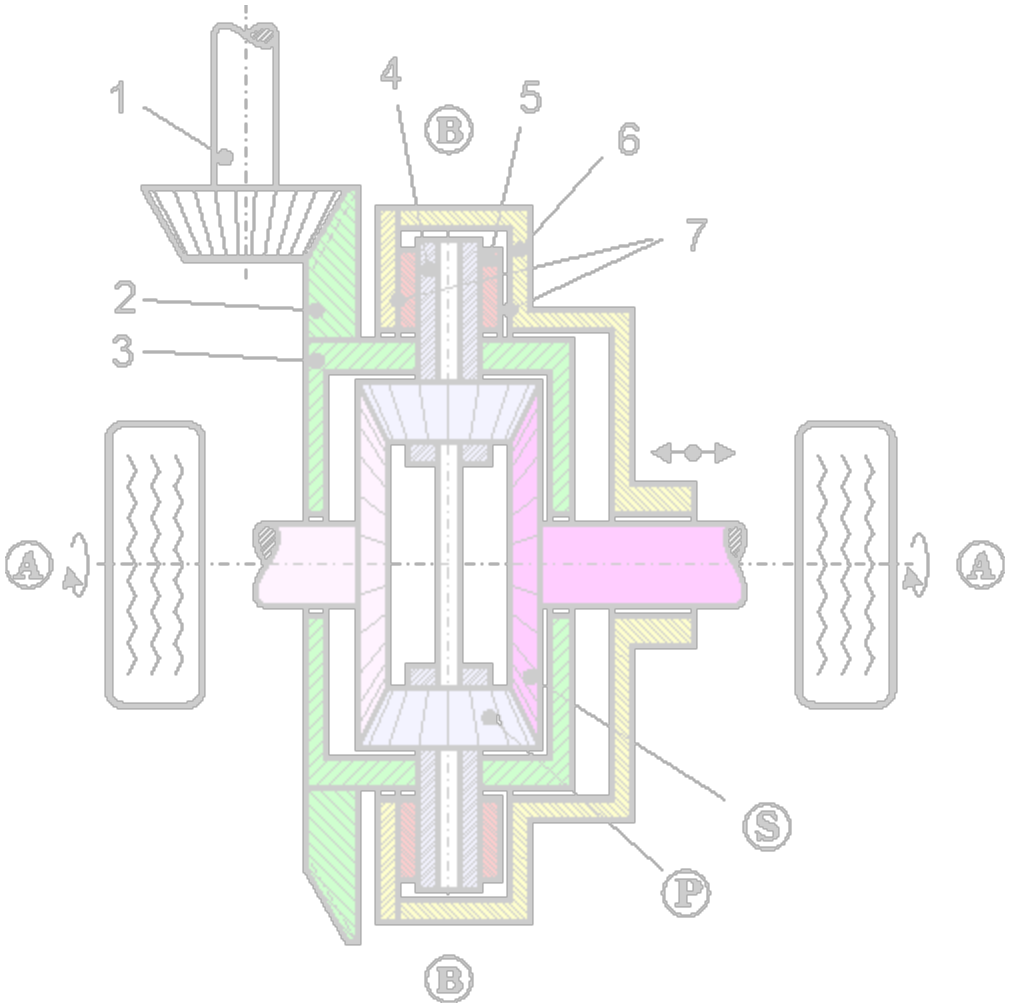
# *Automated Parallel Parking*

- Available on Lexus LS460
- Optional on Toyota Prius
- Similar system by Bosch available in 2008

# *Lexus Automatic Parking*

# *Chassis / Vehicle System Electronics*

- Hybrids
  - Charging / Discharging
  - Performance
  - Plug-in
  - Torque vectoring
- Power control
- Safety systems
  - Anti-rollover
  - System monitoring

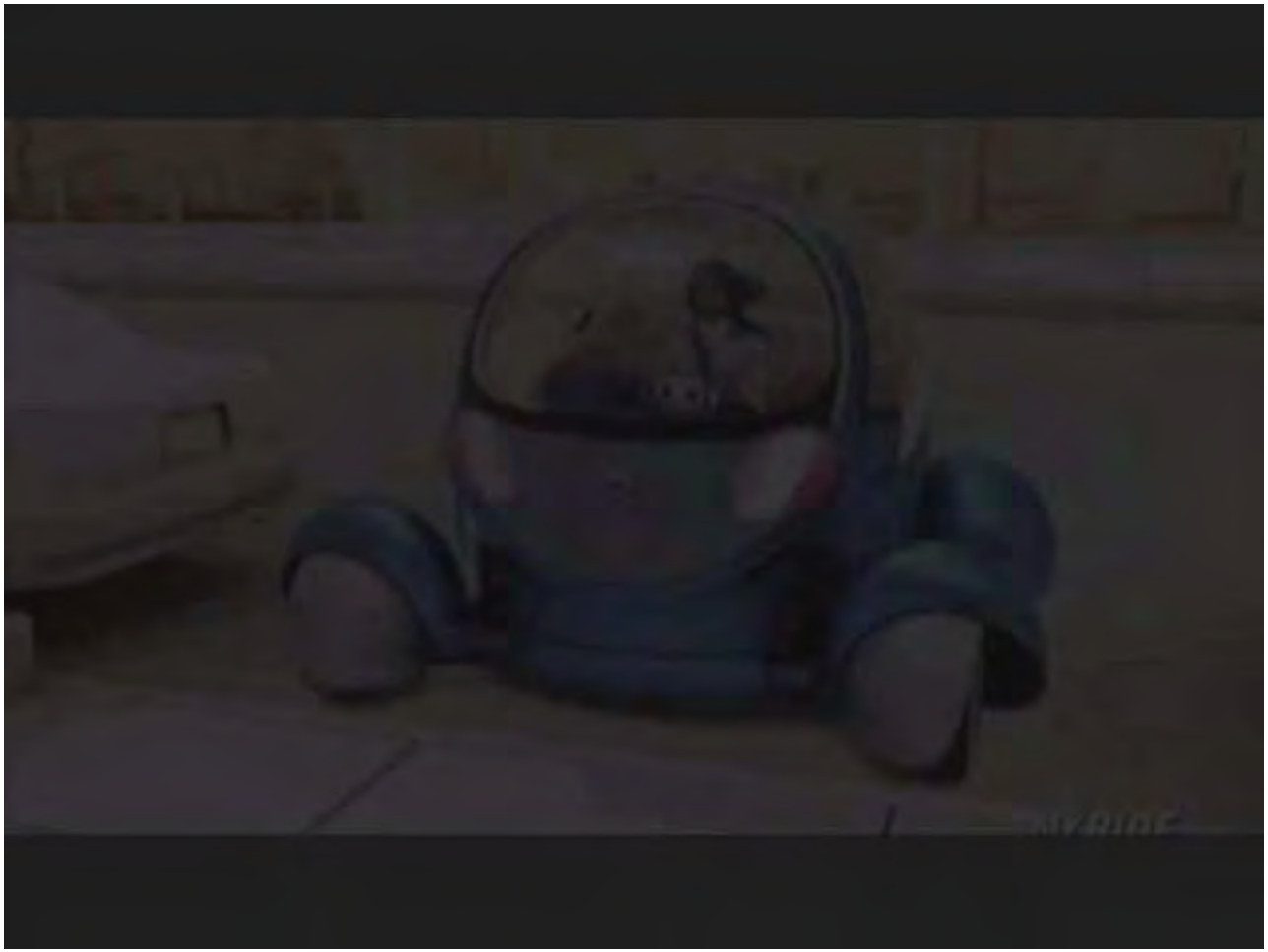


# *Modularity*

GM Skateboard


BMW Life Drive (i3)

# *Plug-In Vehicles are Just the Start*



# *Tractor on Snow / Ice – Maneuvering*

# *Tractor Trailer on Snow / Ice*

# *New ESC Challenges*

- Increased flexibility
- Variable CG
- Lighter weight

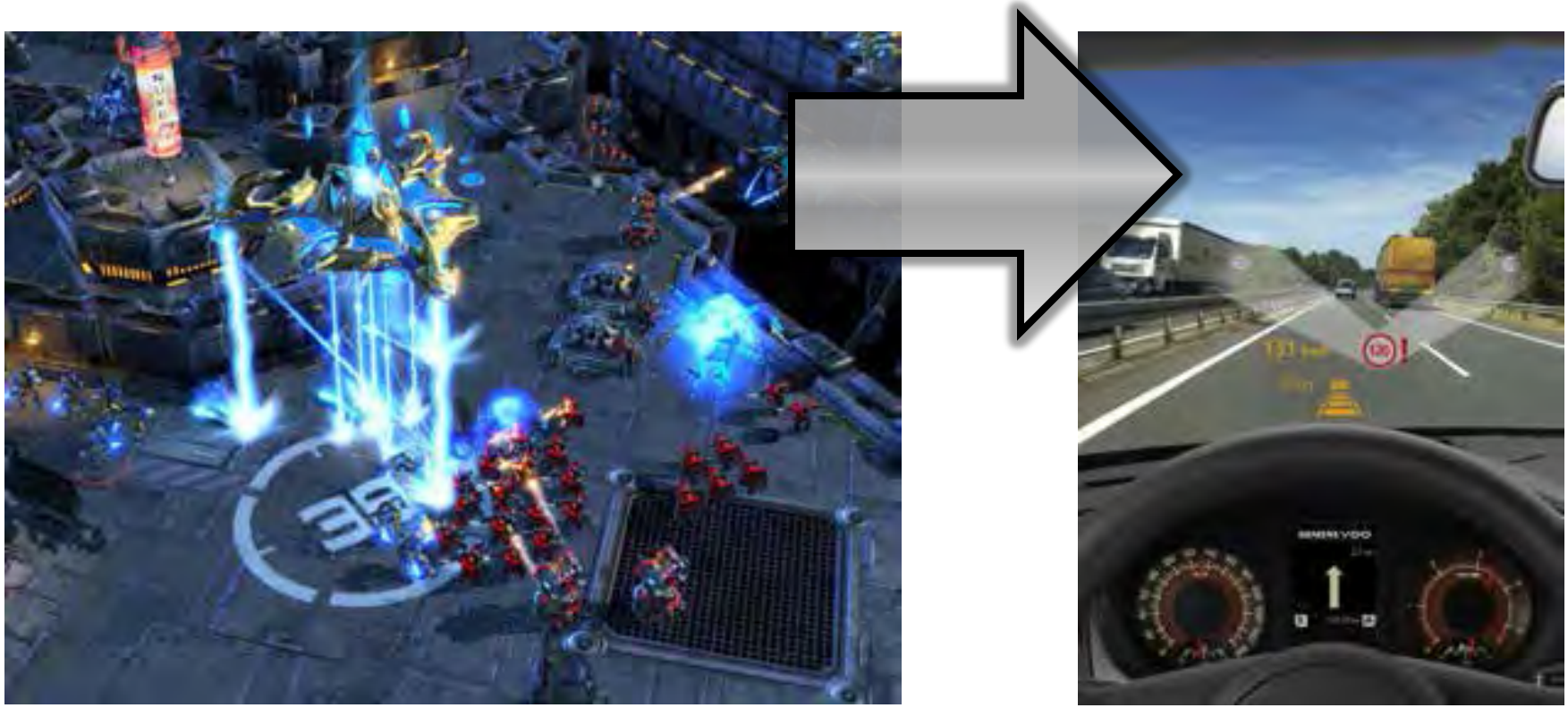
UMTRI (Winkler)

# *Increased Vehicle Automation*

# *What's Next?*

- GPS, RADIO, Wireless internet, Cell Phone integration…
- 3-D Navigation (Google, NVidia, Volkswagen)
- Car to Car LAN
- Car to Infrastructure LAN
- Reconfigurability

# *Game to Vehicle Technology*



# *The Future for the Car*

- Performance
  - Fuel economy
  - Emissions
  - Safety
  - Handling
- Infotainment
- Security (a virus?)
- Haptics – driver feedback
- Systems integration
- Policy
  - Safety systems (e.g., airbags, tire pressure sensors)
  - Responsibility
- The “Camera” scenario

# *The Future for the United States*

- Education at all levels
- A Single State
  - Jobs – too many?
- The Southeastern U.S.
- The United States of America
  - Automotive
  - Manufacturing
- The World

**In times of change, learners inherit the earth; while the learned find themselves beautifully equipped to deal with a world that no longer exists. (Eric Hoffer 1902-1983)**

# *Do Not Underestimate the Human Factor*