



Automotive

Automotive Market and Industry Update

Steve Nelson

Director, Global Automotive Marketing

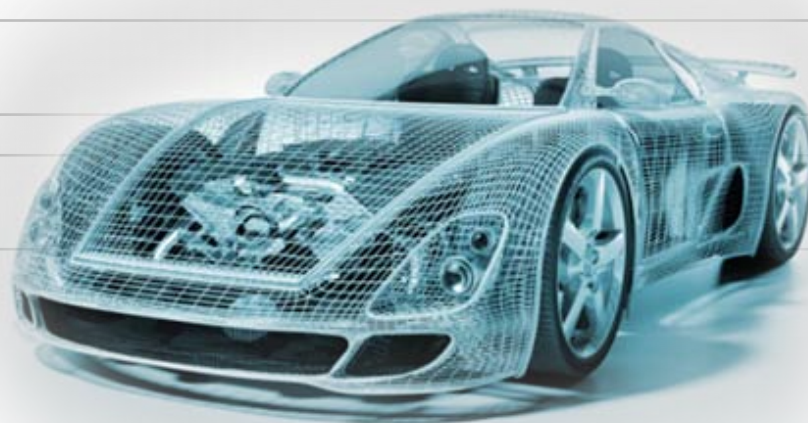


FTF-AUT-F0747



Agenda

- 1 Freescale in Automotive
- 2 What a Difference a Year Makes
- 3 Current Market Trends
- 4 Segment Trends: Body, Chassis/Safety, Powertrain, Driver Information
- 5 What Does the Future Hold?
- 6 Conclusion



Select Sub-Segments **Industrial**

Automotive Core Markets

Networking

Select Sub-Segments **Consumer**



Appliance Control



Home Portable Medical



Smart Meters, Smart Grids



Factory Automation & Drives



Body & Security



Powertrain & Hybrid



Chassis & Safety



Driver Infotainment



Basestations & Controllers



Routers & Switches



Security Appliances



Printers & Gateways



Smart Books



eBooks



RF Remote Controls



Sensors for Phones & Games

Automotive Market: Driving Technology Confluence



Automotive



• Safety



• Fuel Economy and Emissions



• Comfort/Entertainment



Networking



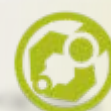
- Wireless everywhere
- Broadband expansion
- Ubiquitous Connectivity

Consumer



- Health
- Energy Management
- Home Entertainment

Industrial



- Connectivity
- Medical/TeleHealth
- Smart Grid/Building Control



Going Green

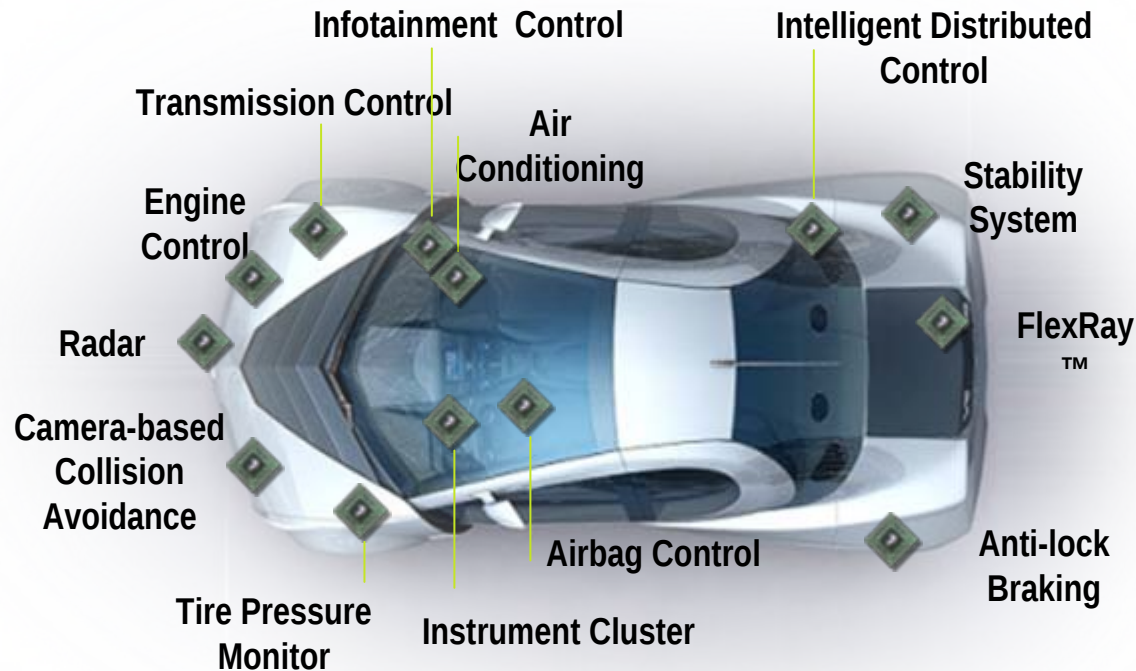


Health & Safety



Net Effect

Technology That Changes the World



No.2 in total auto ICs
No.1 in auto microcontrollers
No.2 in MEMS sensors



Freescal Automotive–Today's Innovation



Chevy Camaro
MCF5251
PDIM



Mercedes S Class
MPC5200
Night Vision



Lincoln MKS
S12
Body Control



Chevy Malibu
MCP5200
OnStar



Cadillac CTS
MPC5566
Direct Injection



Aston Martin DB9
Sensors
Airbag



BMW X5
MPC5567 & S12X
Dynamic Drive



Toyota Prius
DBUS
Master/Slave Airbag



Dayun
S12
Fuel Injection



Peugeot 407
MPC561
ECU



BMW 7-Series
MPC5567
Body Gateway



Honda Stepwagon
Pictus MCU & Ocotillo
Sensor Airbag



Ford Fiesta
S12XHZ
Cluster



Chery A516
S12
HVAC, Powertrain



Opel Corsa
Sensors
Airbag



Ford Fusion
i.MX31
Sync



Mazda Alexa (3)
SPC5565
Start/Stop System



Ducati 696
S12 & Pressure Sensor
ECU



BYD F3
MCU
Body, Cluster



Ford F150
SPQ1035
eSwitch Body

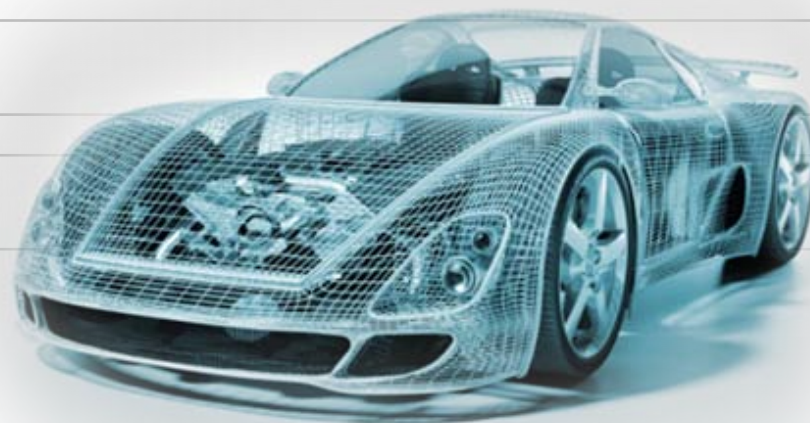
Note: Representative only. All of these products have multiple Freescale devices in many applications.

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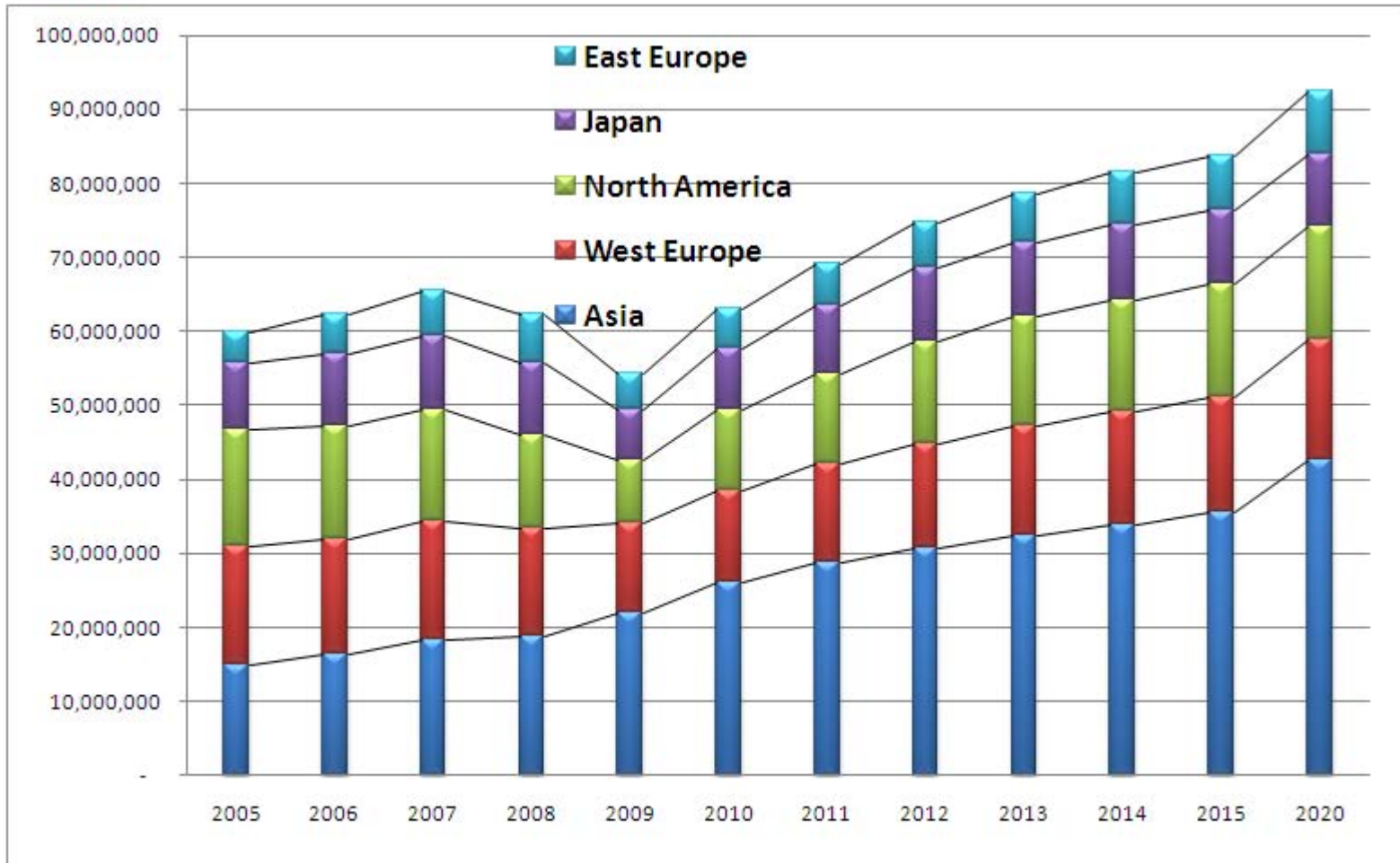
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Global Auto Production Forecast (includes light trucks)

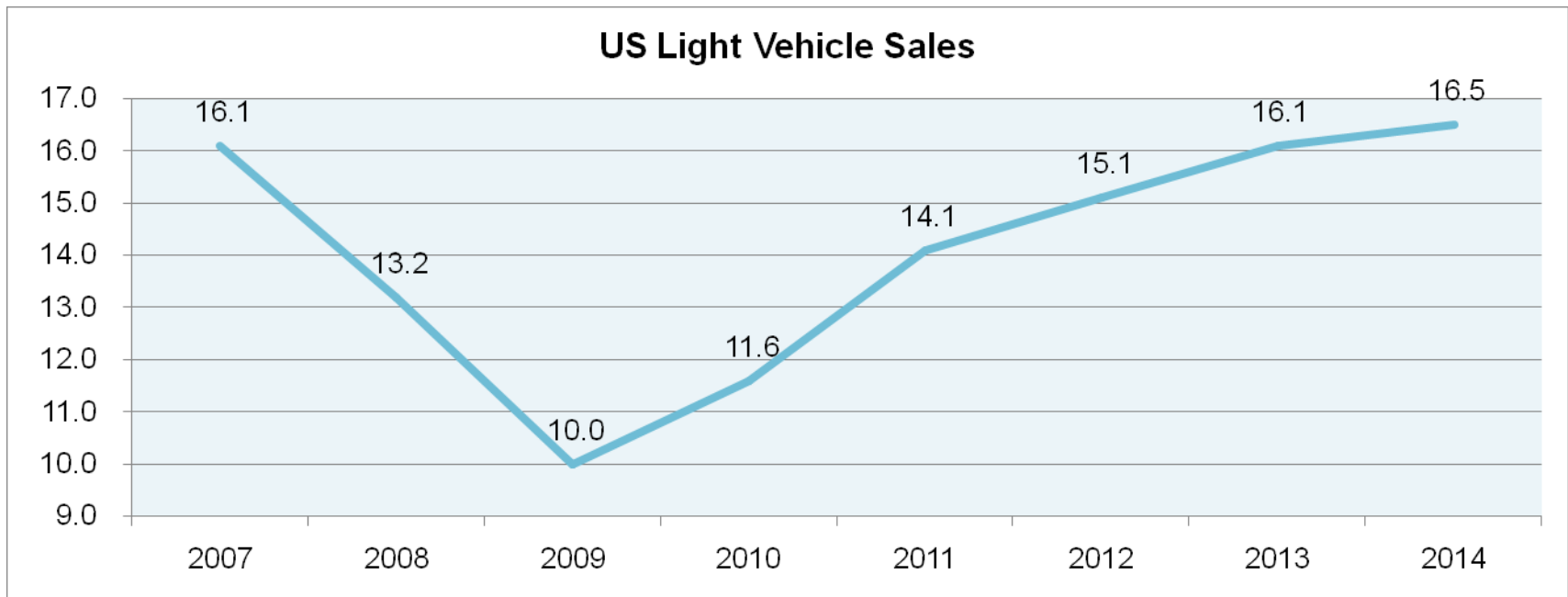
What a difference two years makes



Global Insight April 2010

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- ▶ Scrappage rate ~13MU / year
- ▶ Industry break even ~10-11MU but not healthy until ~12MU+
- ▶ Auto industry employment +15K in 2010, +100K per year 2011-13



What's Important in Today's Automotive Market?

► Fun

- Performance
- Traffic
- Driver assistance

► Safe

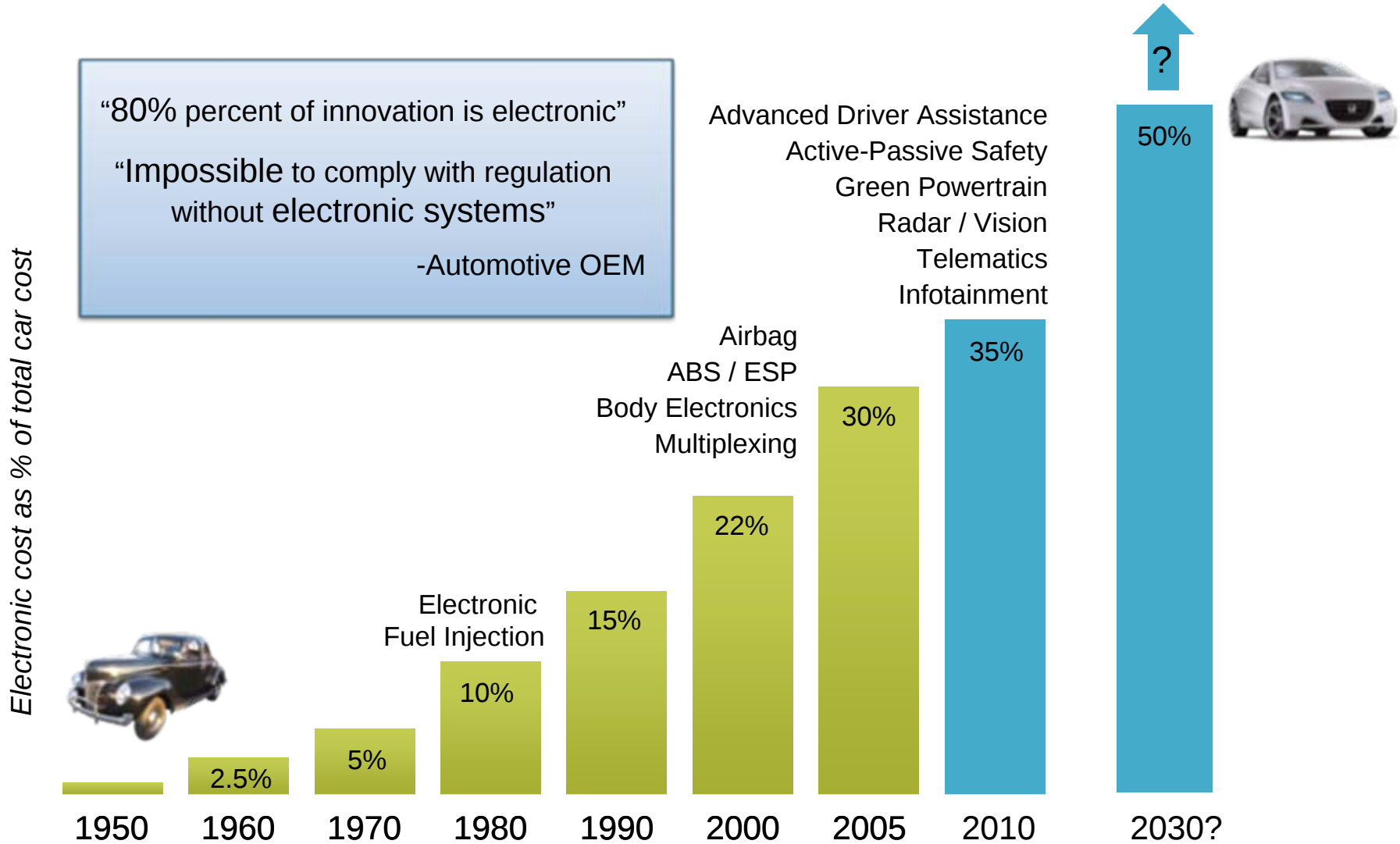
- Accident avoidance
- Occupant protection
- Reliability

► Sustainable

- Low impact on the environment
- Production, use and recycle



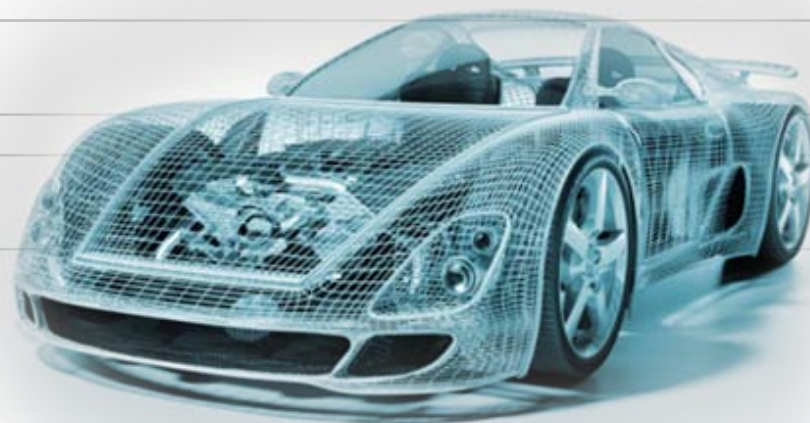
Automotive Electronic Content Growth





Agenda

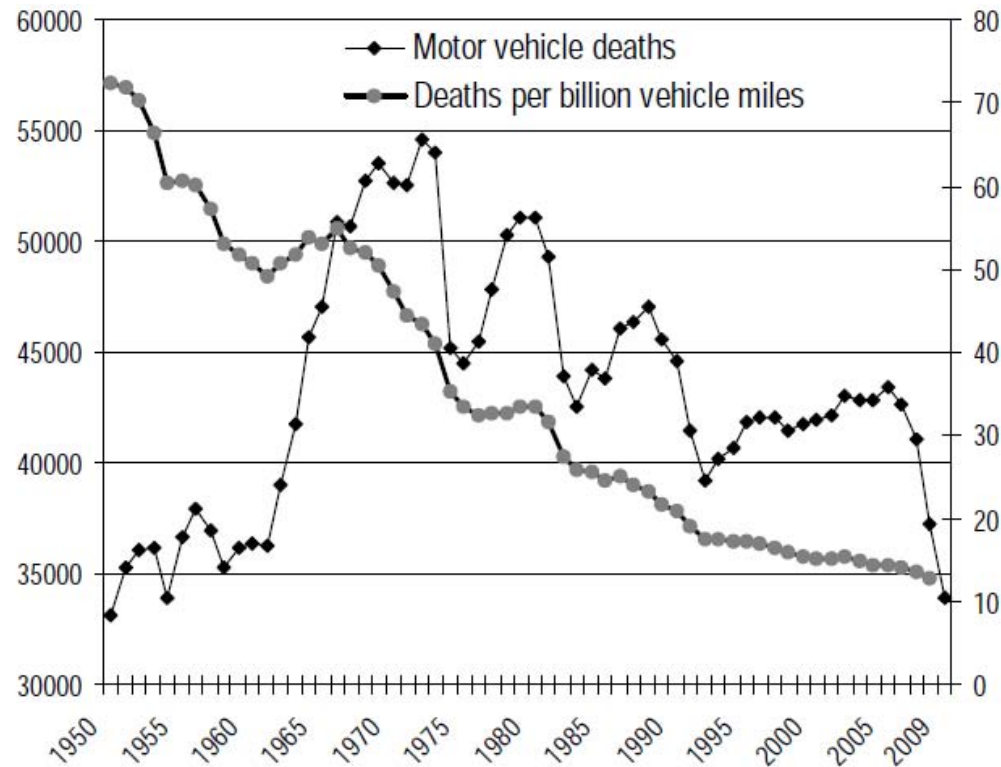
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Electronics – the Source of Improved Safety

More Cars
Higher Speeds
Higher Density
↓
Fewer Deaths

1959 BelAire vs. 2008 Malibu



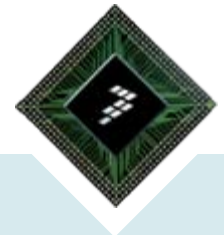
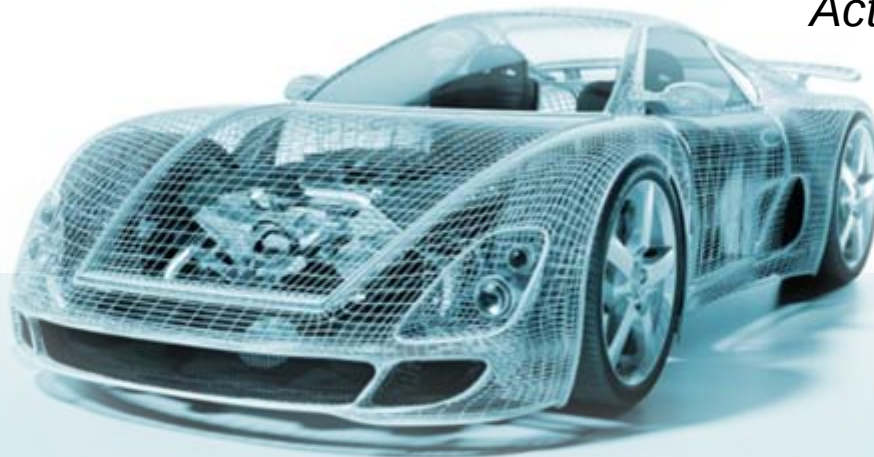
Data: Insurance Institute for Highway Safety; iihs.org

“As more electronic sensors and computing capability are incorporated into modern vehicles, the vehicle manufactures now have the technology to enhance safety in a way that was impossible a decade ago. We believe that many of these technologies can detect and compensate for driver errors such as inattention, drowsiness, or driver misjudgment.”

Ronald Medford

Acting Deputy Administrator, NHTSA

May 2009



“A car with a sense of survival”

CNET review of 2011 Infiniti EX

Common Errors of Older and Younger Drivers

► Most Common Errors of Older Drivers

• Scans side to side	86%	←	<i>Lane Departure Warning</i>
• Scans to rear/head check	84%	←	<i>Blind Spot Detection</i>
• Centers car in lane	49%	←	<i>Lane Departure Warning</i>
• Safe following distance	57%	←	<i>Front Collision Warning, Brake Assist</i>
• Backup up	69%	←	<i>Parking Aid, Camera/Radar</i>
• Lane changes	86%	←	<i>Lane Departure Warning, Blind Spot Detection</i>
• Speed regulation	62%	←	<i>ICC, Front Collision Warning</i>

► Most Common Errors of Younger Drivers

• Distracted driving	←	<i>Intelligent Control, DIS</i>
• Speeding	←	<i>Intelligent Control, DIS</i>
• Following too closely	←	<i>Front Collision Warning, Brake Assist</i>
• Driving drowsy	←	<i>Driver Monitoring Systems</i>

AAA Foundation for Traffic Safety
% scoring fair or poor on given item

► Occupant vs Vehicle Factors: What's more important?

- DFSS – factor analysis 135 frontal crashes cases

<u>Variable</u>	<u>#1 Influential</u>	<u>#2 influential</u>
Clavicle	Sex + Model Yr.	Weight
All Thoracic	Age	Weight
Upper abdomen	L4 density	Age
Lower abdomen	Sex + L4 density	Model Year
All spine injury	Pretensioner	Pret + Sex
Thoracic Skeletal + Clavicle	Age	Sex
Th. Org & Vessel + Upp	Delta V + Wt	Delta V
Sum of Skeletal Injury	Age	Sex
Sum of Organ Injury	L4 density	Weight



- Occupant factor most influential for **8 of 9** injury outcome measures and second most influential in **7 of 9**.

► Cars must adapt safety systems based on human factors

► Adoption of EDR and Telematics can provide estimates of injuries to emergency personnel before they arrive at a crash

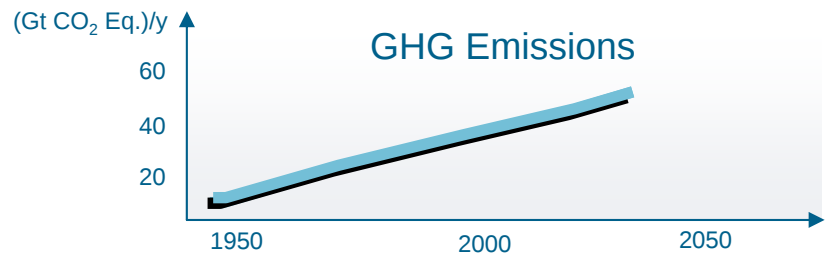
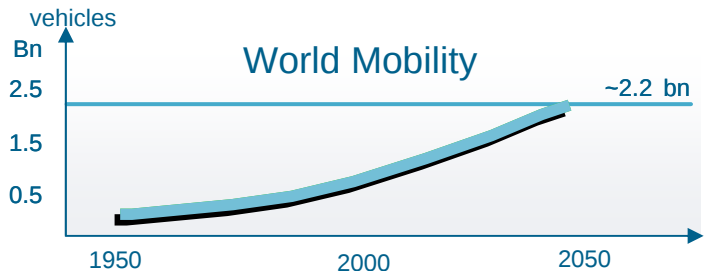
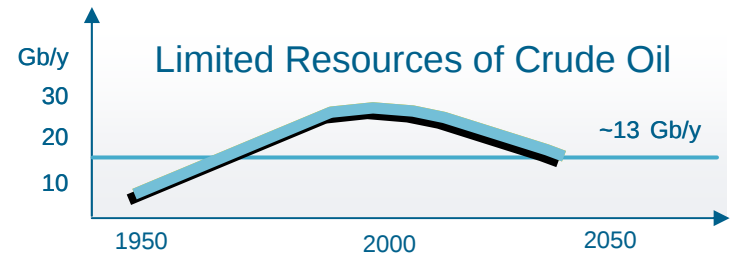
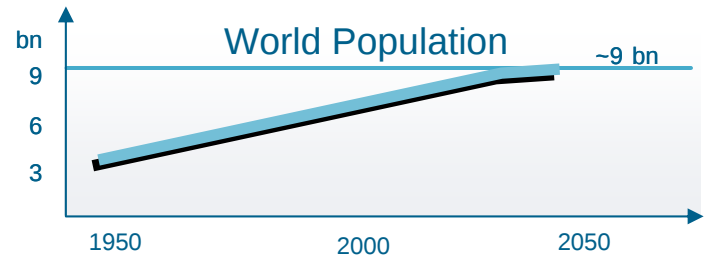
Collision Warning and Avoidance

- ▶ Lane departure warning/prevention systems could prevent/mitigate up to 483,000 crashes per year, including 87,000 non-fatal injury and 10,345 fatal crashes
- ▶ Forward collision warning/mitigation systems could potentially prevent or reduce the severity of 2.3 million crashes in the United States each year, including 1.4 million front-to-rear crashes.
 - These improvements could prevent up to 210,000 non-fatal injury crashes and 7,166 fatal crashes each year.
- ▶ Blind spot detection/warning and emergency brake assist could prevent 457,000 and 417,000 crashes per year, respectively.
- ▶ One second of notification can eliminate 90% of front end collisions

Source: Insurance Institute for Highway Safety

Issues: Fundamentally the Same

- ▶ Increasing world wide population
- ▶ Increasing energy usage and shortage of oil
- ▶ Increasing World Mobility
- ▶ Too much Greenhouse Gas emissions



New Idea?

Ferdinand Porsche, an employee of **Jacob Lohner & Co.** in Vienna, Austria developed a **drive system** based on fitting an **electric motor** to each front wheel without transmissions (hub mounted).

Vehicles of this type were known as **Lohner-Porsches** and were sold in 1898-1906.



What's changed Government Regulations and Incentives



DETROIT ELECTRIC CARS
J. F. HAYDEN, Agent

High Point, N. C.

Since gasoline automobiles are being made more complicated every year, and still many inherent difficulties not yet overcome, and with the **cost of gasoline advancing**, I am forcibly convinced that with the **recent improvement in storage batteries** the Electric Automobile will largely supersede the gas cars.

Global Regulations Drive Innovation and Content



The new CAFE standards must **achieve by 2016 a combined average** fuel-economy standard of 35.5 mpg—39 mpg for cars and 30 mpg for light trucks and SUVs—a **40 percent improvement** over current standards.



Emission standards are being adopted in China by the State Environmental Protection Administration ([SEPA](#)). Chinese standards are **based on European regulations**. Focus investment area-HEV and Fuel Cell.



Japan' emissions standards in 2009 with further limits about NOx and PM to a level in-between the US 2010 and Euro 5 requirements.



Euro 6 standards effective from fall 2014, with a target to reach 95g CO2 by 2020



Infrastructure & Power Requirements

- Charging infrastructure
 - @ Home
 - @ Public areas
 - @ Work
- Normal & Rapid charge options

Product Development

- Powertrain technology
- Chassis & body technology
- Energy storage technology
- High performance @ reasonable cost

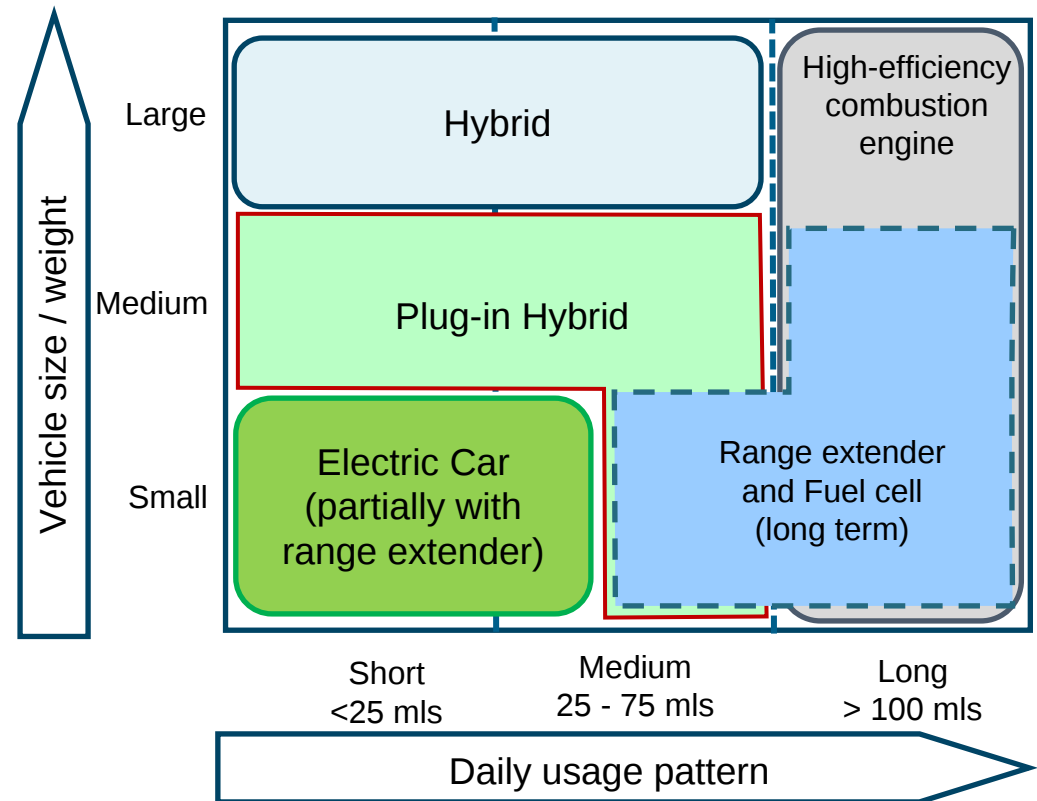
Business Model Innovations

- Alliance of OEM & key component suppliers
- Linkage between Government policy, Energy suppliers, Key technology innovators critical for success
- Taxes



► Influences

- **Location:** 80% of Americans drive <50 miles, 70% of Europeans drive < 25miles
- **Application:** EV / Hybrid for city, high efficiency combustion engines for highway/commercial
- **Cost:** Upfront cost tolerance vs. life cycle consumer benefits



Source: Bain

WSJ: Electric cars Fall Short in Mini Test, "most significant effect on range is interior temperature" 6/3/10

Efficiency Requires Improvements in Many Areas



Powertrain

- Hi Precision/Direct Injection
- Single/Multiple Turbo
- Improved Transmissions
- Start/Stop
- Mild/Full Hybrid
- EV



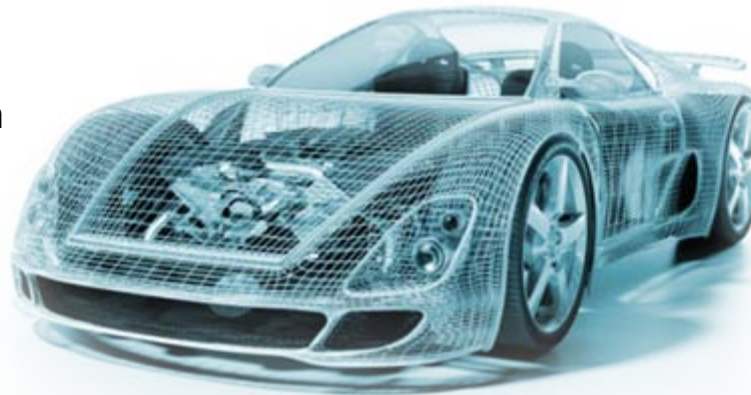
Prediction

- Driver behavior
- Route topology
- Weather
- Managed Infrastructure



Resistance

- Rolling Resistance
- Light Weight Materials
- Cable harnesses
- Reduced Hydraulics
- Increased Electrification
- Active Aerodynamics

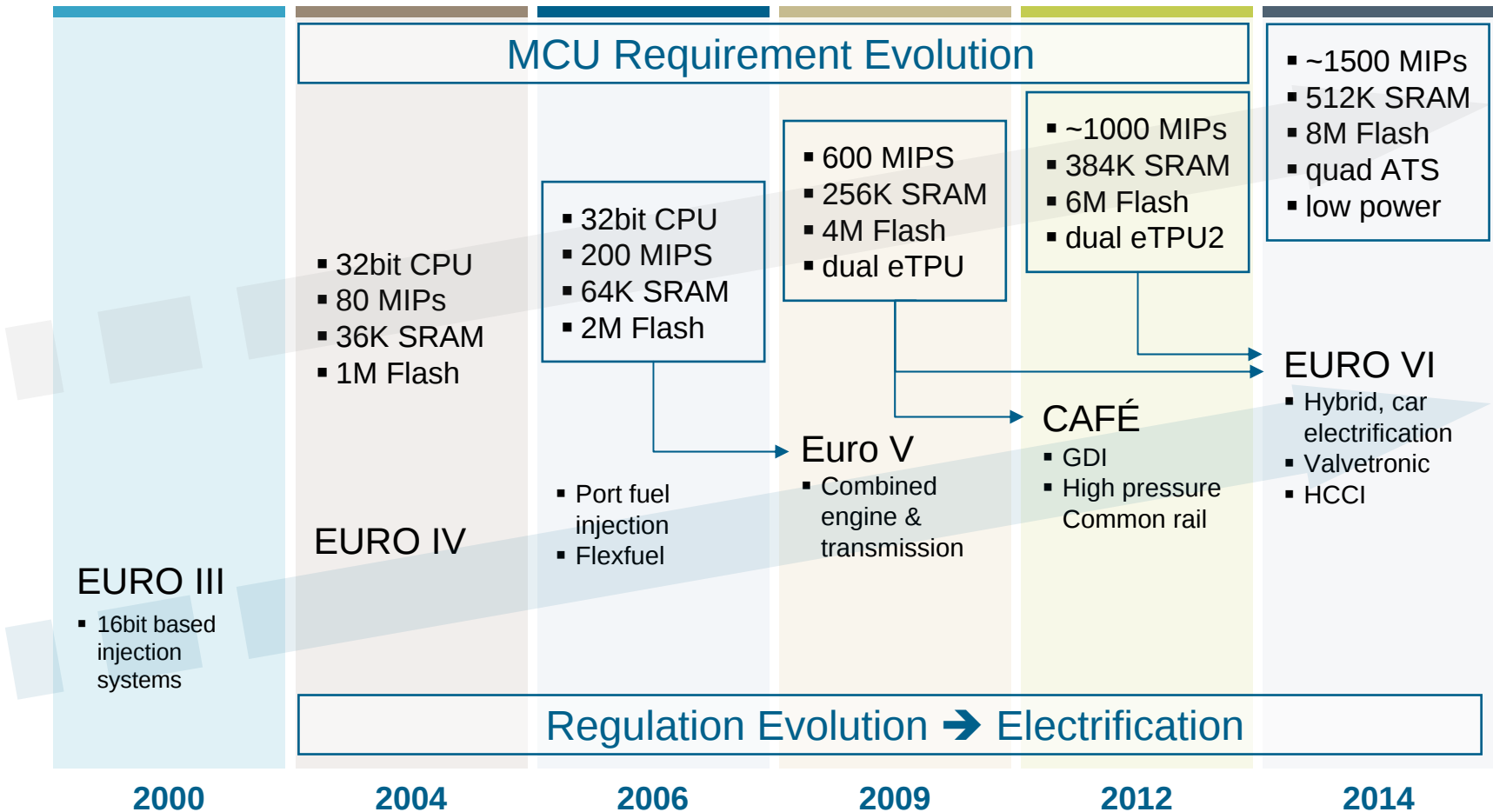


Energy Sources

- Bio Diesel
- Gasoline
- Natural Gas
- Alternative Fuels
- Hydrogen
- Electric

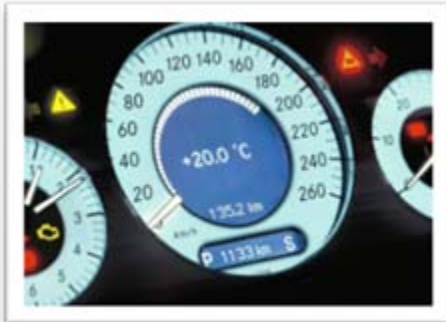
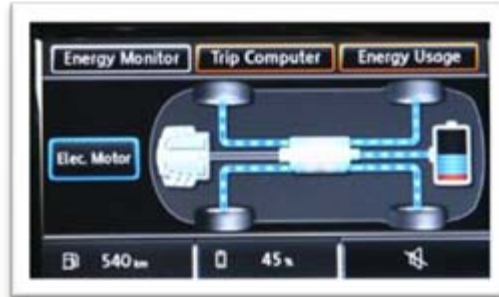


Legislation Drives MCU Powertrain

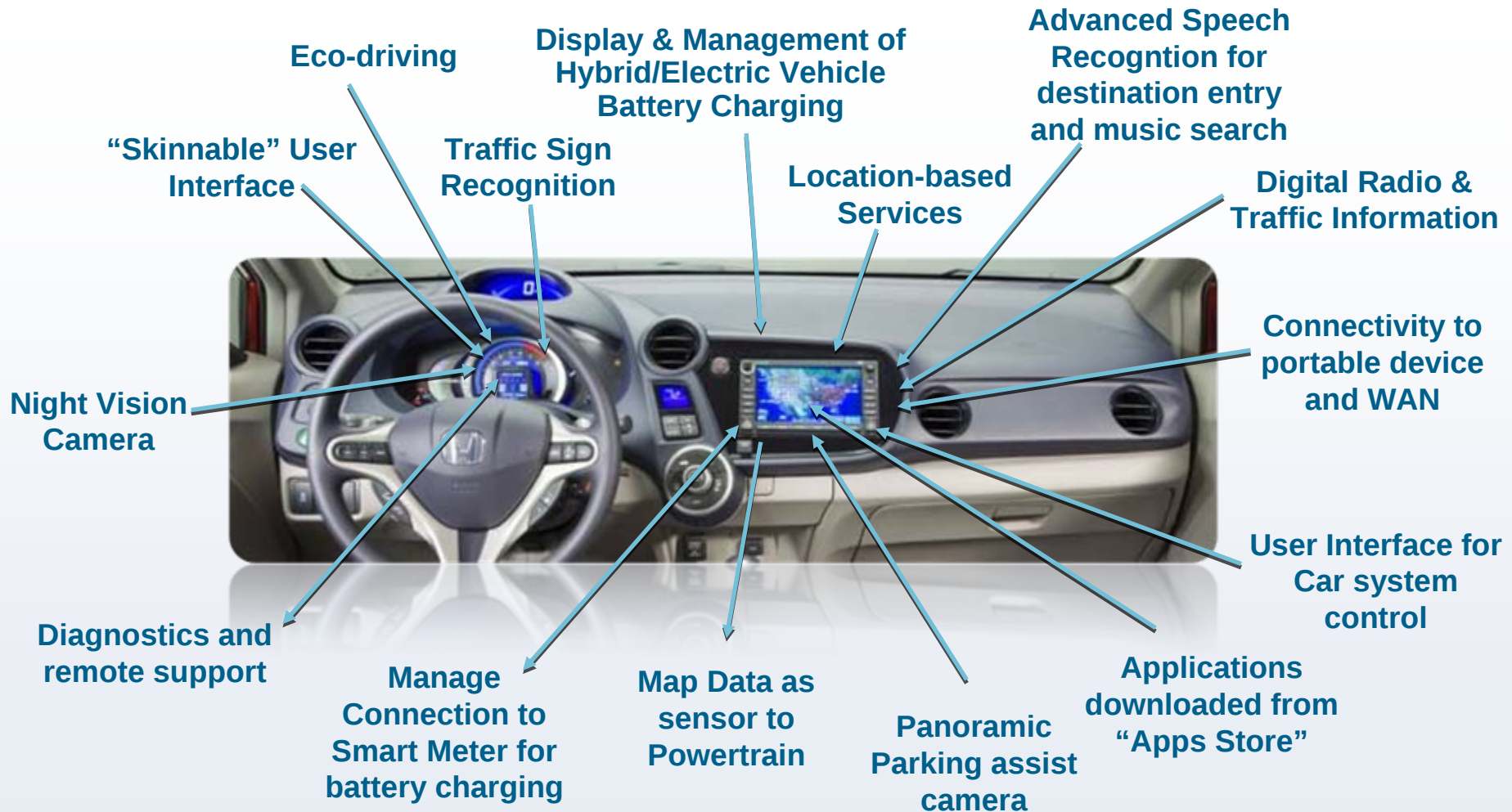


Instrument Clusters

Critical Branding and Differentiation Point



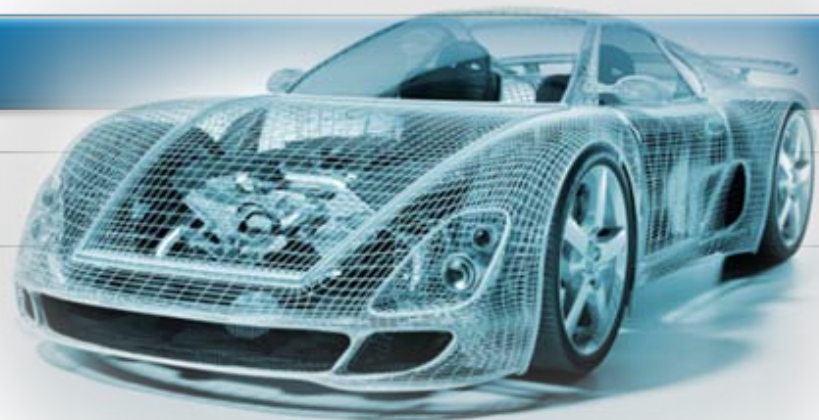
Information Explosion or Driver Overload?





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Future Architecture Challenges

► Power

- Customers requesting 50% reduction in power over existing architecture while increasing complexity

► Performance

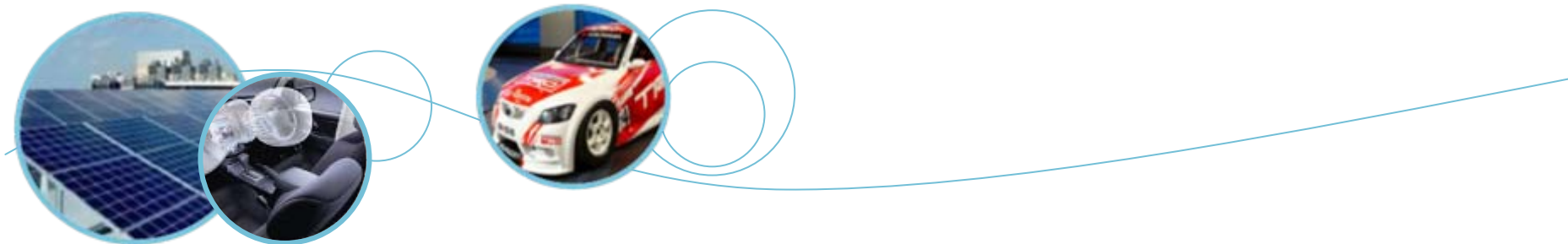
- Customers requesting up to x5 performance over existing architecture

► Functional Safety

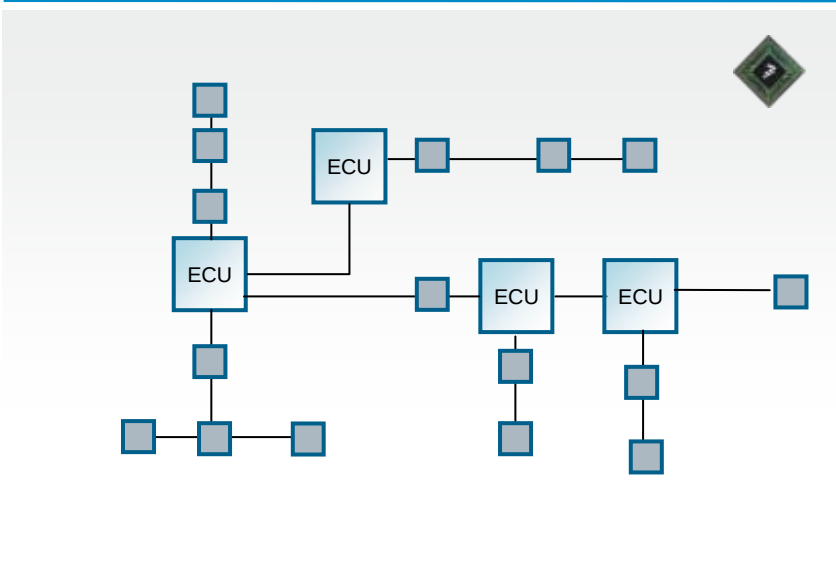
- Compliance to IEC61508 and ISO26262 standards

► Lower Cost of Ownership

- Lower ASPs!!!
- Reduced development costs
- Faster time to market



Today

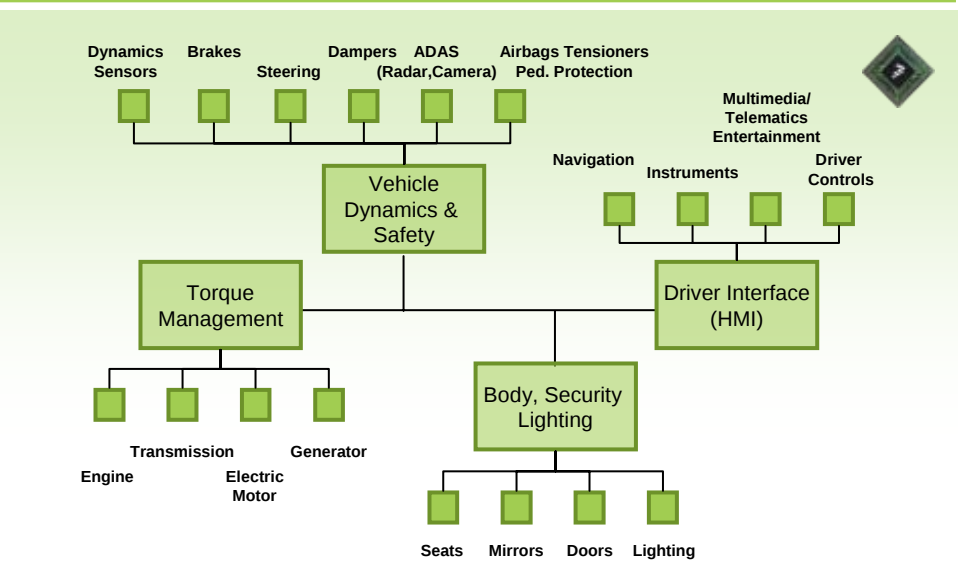


Distributed Electronic Control Units

One ECU per mechanical function- Connected by multiple CAN and LIN interfaces

- Number of ECUs increases with the addition of features and vehicle options.
- 
 - High systems and software complexity.
 - Difficult integration

Future



Distributed Computing

Major computing nodes on a high performance network organized by “domains” which control “zones”

- High performance multi-core domain controllers with guaranteed safety and security of operation.
- Lower performance but highly integrated Zones with direct actuator control.
- Standardized software and OS to ease integration

► Energy Management with Prediction

- Topology
- Traffic Conditions
- Weather / Temperature
- Traffic Signals / State
- Hybrid Energy Usage

All constantly transmitted
to the car's
Energy Management System



- ▶ Improved Navigation
 - Intelligent / Safe routing
 - Out of Area notification
- ▶ Driver Capability and Skill
 - Alertness
 - Safety event reporting
 - Lane departure
 - Over/Under speed limit
- ▶ Medical Condition Awareness
 - Automatic notification
 - Autonomous operation in medical emergency
 - Integrated medical sensing

Diagnostic Steering Wheel



► Daily Commute Scenario

- Submitted daily commute plan
- Trip logistics transmitted to the car from central auto management
- Departure time
- Routing and speed
- Parking slot

► Issues

- Ad-Hoc driving
- Biology breaks
- Essence of personal transportation



► Extension of your 'Virtual Self'

- Car Configuration
- Personal and Business Content
- Real time interaction with the outside world
- Personal Privacy?



Western Hemisphere vs. BRIC

Criteria	Unit	USA	EU27	Japan	Total or Avg.	Brazil	Russia	India	China	Total or Avg.	Ratio
Population	Mil hab	307	491	127	925	198	140	1166	1338	2842	3.07
GDP per capita	US\$	\$47,000	\$33,400	\$34,200	\$38,024	\$10,100	\$15,800	\$2,800	\$6,000	\$5456	0.14
Land area	Mil sq km	9.1	4.3	0.374	13.774	8.4	16.9	2.9	9.3	37.5	2.72
Total road	'000s of km	6465	5454	1196	13115	1751	933	3316	1930	7930	0.60
Car park	Mio of cars	240	250	61	551	24	38	13	37	111	0.20
Car density	# cars per 1000 hab.	782	509	480	596	123	268	11	27	39	0.07
Car density	# cars per km of road	37	46	51	42	14	40	4	19	14	0.33

Developed Infrastructure for Transportation Management will be Critical

Source: US Central Intelligence Agency – CIA, world fact book

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Smart Highways Tomorrow: Vehicle – Road Network



- ▶ Sensor / Radar / Camera networks
- ▶ Automated driving
- ▶ Vehicle – Road / Vehicle – Vehicle Communications
- ▶ Predictive safety
- ▶ Platoon: Increased traffic density at higher speeds

prediction – Critical Factor in Next Generation Transportation



Safety – milliseconds save lives, collision avoidance, post crash
 Efficiency – routing, navigation, consumption
 Driver Information – driver decisions

ZERO

- Emissions
- Fatalities
- Defects

Electronics are imperative to balancing increasing individual transportation and reducing fuel cost, emissions and casualties.

Consumer awareness, legislation and competitive differentiation join forces driving automotive electronics

Automotive Solutions: Helping you with System Solutions

Driving Solutions

Tools Innovations

AUTOSAR

What is AUTOSAR?

AUTOSAR is a standard for automotive software architecture. It provides a common framework for developing automotive software, regardless of the hardware platform, the operating system, or the programming language. AUTOSAR is a multi-layered architecture that defines the software components and their interactions. It is designed to be flexible and scalable, allowing for the development of software for a wide range of automotive applications.

Benefits of AUTOSAR:

- **Standardization:** Provides a common framework for software development, reducing complexity and increasing interoperability.
- **Flexibility:** Allows for the development of software for a wide range of hardware platforms and operating systems.
- **Scalability:** Supports the development of software for a wide range of automotive applications, from small cars to large trucks.

Adaptive Cruise Control and Automotive Radar

Adaptive Cruise Control (ACC) is a safety feature that allows a vehicle to maintain a safe distance from the vehicle ahead. It uses radar sensors to detect the vehicle ahead and adjusts the throttle and brakes accordingly. ACC is typically used in conjunction with a driver's manual control, but some systems can operate autonomously.

Automotive Radar is a sensor that uses radio waves to detect the presence of objects around a vehicle. It is typically used for collision avoidance and lane-keeping assistance. Radar sensors can detect the range, speed, and direction of objects, allowing for more accurate and reliable detection than other sensors like cameras or lidar.

Partner Support/Tools

Partner Support/Tools are software tools that are used to develop and test automotive software. They typically provide a range of features, including code generation, simulation, and testing. Partner Support/Tools are often used by automotive manufacturers and their suppliers to develop and test software for a wide range of automotive applications.

Benefits of Partner Support/Tools:

- **Efficiency:** Reduces the time and cost of software development and testing.
- **Quality:** Improves the quality of the software by providing a range of testing and simulation capabilities.
- **Interoperability:** Ensures that the software developed using the tools is compatible with the hardware and other software components.

Gasoline Engine Management

Gasoline Engine Management is the process of controlling the operation of a gasoline engine. It involves managing the air-fuel mixture, the timing of the spark plugs, and the throttle position. Engine management systems are designed to optimize engine performance, fuel efficiency, and emissions.

Components of Gasoline Engine Management:

- **Engine Control Unit (ECU):** The central computer that manages the engine's operation.
- **Sensors:** Devices that provide feedback to the ECU, such as oxygen sensors, throttle position sensors, and crankshaft position sensors.
- **Actuators:** Devices that receive commands from the ECU and control the engine's operation, such as the throttle body and fuel injectors.

Software Tools

Software Tools are programs that are used to develop and test software. They typically provide a range of features, including code generation, simulation, and testing. Software Tools are often used by software developers to develop and test software for a wide range of applications.

Benefits of Software Tools:

- **Efficiency:** Reduces the time and cost of software development and testing.
- **Quality:** Improves the quality of the software by providing a range of testing and simulation capabilities.
- **Interoperability:** Ensures that the software developed using the tools is compatible with the hardware and other software components.

Hybrid Drive Train

Hybrid Drive Train is a powertrain that combines a gasoline engine and an electric motor. It allows a vehicle to operate in either a gasoline-only mode or a hybrid mode, where the gasoline engine and electric motor work together to provide power. Hybrid drive trains are designed to improve fuel efficiency and reduce emissions.

Components of Hybrid Drive Train:

- **Gasoline Engine:** The internal combustion engine that provides power.
- **Electric Motor:** The electric motor that provides additional power.
- **Transmission:** The device that transfers power from the engine and motor to the wheels.
- **Battery Pack:** The storage device for the electric energy.

Hybrid drive trains are typically used in vehicles that are designed for improved fuel efficiency and reduced emissions. They are often used in conjunction with regenerative braking, which allows the electric motor to act as a generator and recharge the battery pack.

Airbag System

Airbag System is a safety feature that uses inflatable airbags to protect occupants in the event of a collision. The airbags are typically located in the dashboard, the front seats, and the rear seats. They are designed to inflate rapidly in the event of a collision, providing a cushion for the occupants and reducing the risk of injury.

Components of Airbag System:

- **Airbag Modules:** The inflatable airbags that provide protection.
- **Sensors:** Devices that detect a collision and trigger the inflation of the airbags.
- **Control Unit:** The central computer that manages the operation of the airbag system.

Airbag systems are typically used in conjunction with seat belts to provide the most effective protection for vehicle occupants. They are often used in conjunction with other safety features, such as anti-lock brakes and traction control.

Vehicle Dynamics

Vehicle Dynamics is the study of the forces that act on a vehicle and how they affect its motion. It is a branch of engineering that deals with the design and development of vehicles that are stable, comfortable, and safe. Vehicle dynamics is typically studied using mathematical models and simulation.

Components of Vehicle Dynamics:

- **Chassis:** The frame of the vehicle that supports the engine, transmission, and other components.
- **Suspension:** The system that supports the vehicle's weight and absorbs road irregularities.
- **Steering:** The system that allows the driver to control the direction of the vehicle.
- **Brakes:** The system that slows down or stops the vehicle.

Vehicle dynamics is a complex field of study that involves a wide range of factors, including the vehicle's weight, the distribution of weight, the aerodynamic forces, and the road conditions. It is a critical part of the design and development process for any vehicle.

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