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Episode 13: What about cars?

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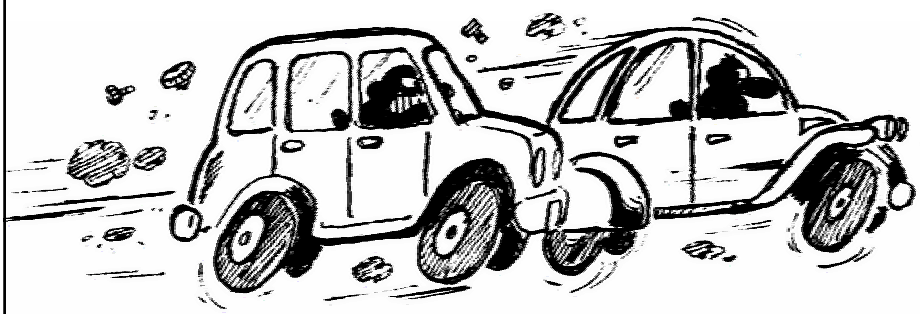
Why are vehicles ideal platforms?

- They are big enough
- They have their own power supply
- They are expensive enough
- At least for germany, they are the primary commercial force and the most precious toy
- They are a major source of pollution
- …
- Telematics
  - Telecommunication and Automation
  - For some it is about computers and mobility

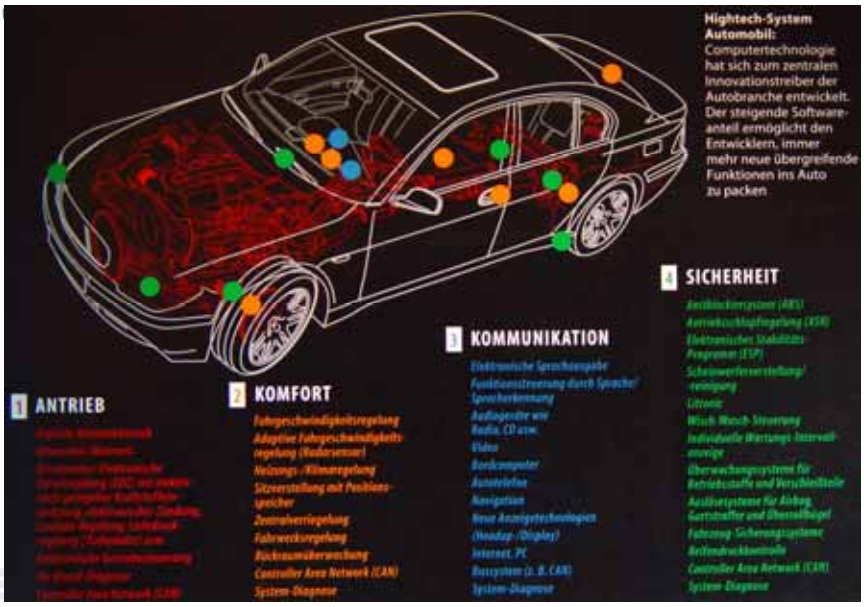
Early Applications

- Mobile communication
- Dynamic route planning
  - Sending actual traffic information to the vehicle
- General Motors, OnStar System
  - Simple to use button at the console connects to a human operator
    - Emergency call
    - Breakdown call
    - Information call
  - Experimented with voice scripting for automation (Voice XML)

How many computers are in your car?



Possibly Many!



Service Categories

- Passenger-oriented services
  - Information services such as OnStar (augmented with position context)
  - Productivity (Email, mobile office, …)
  - Entertainment
    - Mulitmedia Car Platform (MCP)
    - Radio, Video, TV
- vehicle-oriented services
  - Maintenance, on-site inspection, firmware updates, …
  - Security
  - anti-theft devices, …
  - Comfort (heating, air condition, personalization)

Service Categories (contd.)

- Trip-oriented services
  - Optimize energy consumption
  - Safety systems such as ABS, ESP, …
  - Navigation

Collision-Warning Systems

- Forward-collision warning
- Blind-spot warning
- Lane-departure warning
- Lane-change or merge warning
- Intersection-collision warning
- Pedestrian detection and warning
- Backup warning
- Rear-impact warning
- Rollover warning (for heavy vehicles)

Driver Monitoring

- Detect and warn of drowsiness

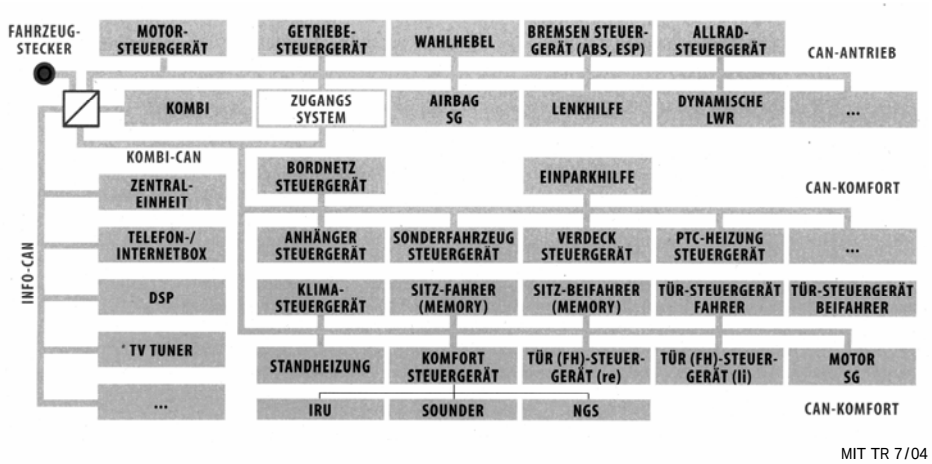
Driver Assistance

- Adaptive cruise control
- Lane keeping
- Precision docking
- Precise maneuvering

Vehicle Automation

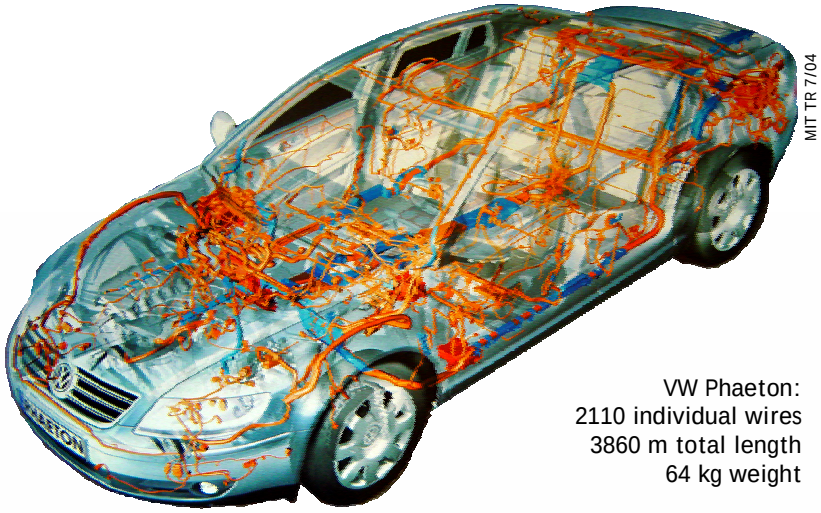
- Low speed automation
- Autonomous driving
- Close-headway platooning

Example VW Touran



MIT TR 7/04

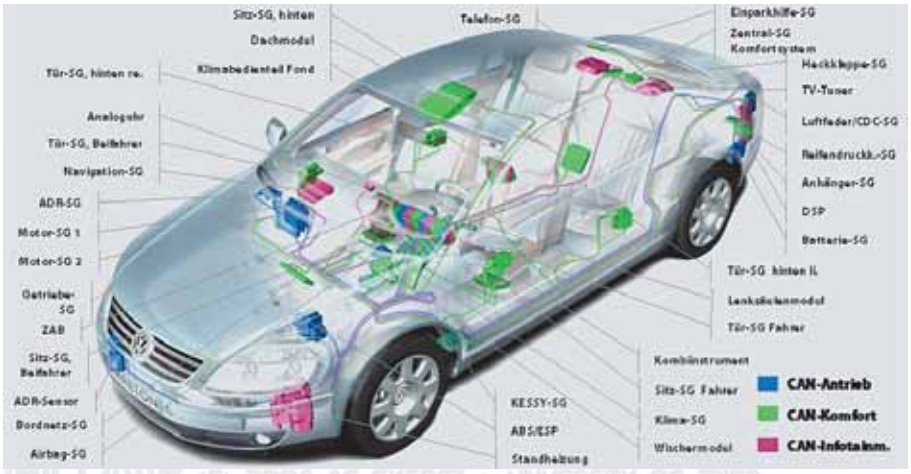
Many computers = long wires



VW Phaeton:
2110 individual wires
3860 m total length
64 kg weight

Inside the vehicle

- Pervasive computing is reality

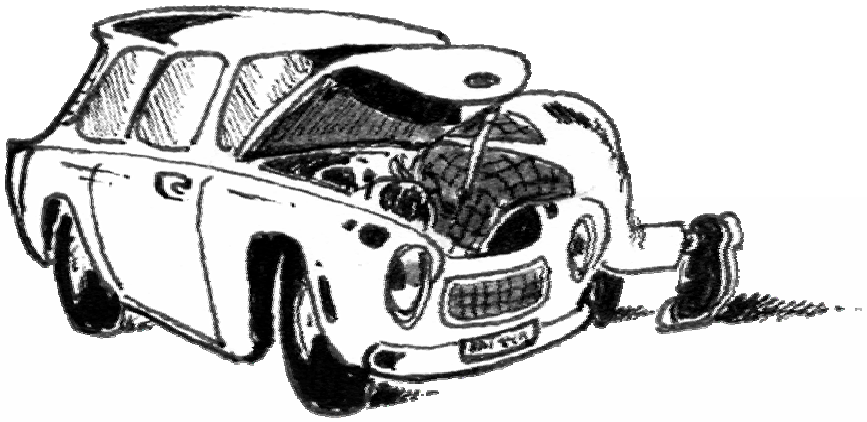


Adaptive Cruise Control (ACC)

X-by-wire

- Electronic control of essential functions
- Suspension-by-wire
  - Change the suspension while driving
- Steer-by-wire
- Brake-by-wire

… and the consequences



Most cars break down because the battery is drained!

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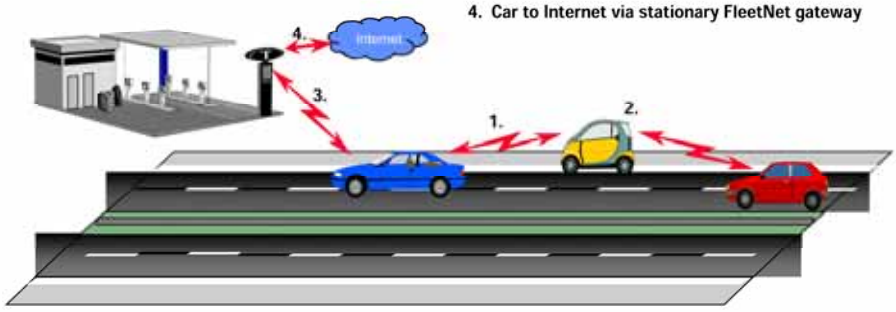
Fleetnet

- German research project
  - Development of a platform for inter-vehicle communication systems
  - Usage of mobile ad-hoc radio networks
- 2000 to 2003
- Consortium
  - DaimlerChrysler AG
  - Fraunhofer Institut FOKUS
  - NEC Europe Ltd.
  - Robert Bosch GmbH
  - Universities of Hannover, Mannheim, Hamburg-Harburg, and Braunschweig
- Funded in parts by BMBF, Germany

Fleetnet Scenario

1. Car-to-car direct
2. Car-to-car via relaying by intermediate cars
3. Car to stationary FleetNet gateway
4. Car to Internet via stationary FleetNet gateway



Aus Franz et al. "Internet on the Road via Inter-Vehicle Communications", 2001 (www.fleetnet.de)

Services and Applications

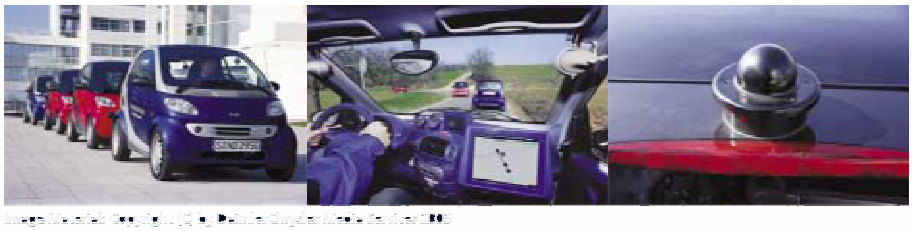
- Cooperative driver-assistance
  - Exchange of sensor data between vehicles (e.g. road condition)
  - Emergency breaking
  - Passing assistance
  - Security distance warning
  - Coordinated lane entering
- Decentralized floating vehicle data applications
  - Inter-vehicle communcation system
  - Recognition of traffic jams
- User communication and information services
  - Accessing the Internet from vehicles

Radio Hardware

- Requirements
  - Minium 1 Mbps data rate
  - Several 100 m communication range
  - Usage of unlicensed frequency band
- Considered candidate hardware
  - WLAN 802.11
  - HIPERLAN Type 2
  - UMTS in time division duplex modes (UTRA-TDD)
  - Communication via Radar (will be used in future cars anyway)
- Speed of cars (200 km/h and more) is a major problem for frame and slot synchronization

Demonstrator

- 6 instrumented Smart cars



Resources

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- R.G. Herrtwich, “Fahrzeuge im Netz”. In “Total Vernetzt”, Hrsg. Friedemann Mattern, Springer, 2003
- R. Bishop, “Intelligent Vehicle Applications Worldwide”, IEEE Intelligent Systems, 2000
- www.fleetnet.de