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Embedded System Design

Communication

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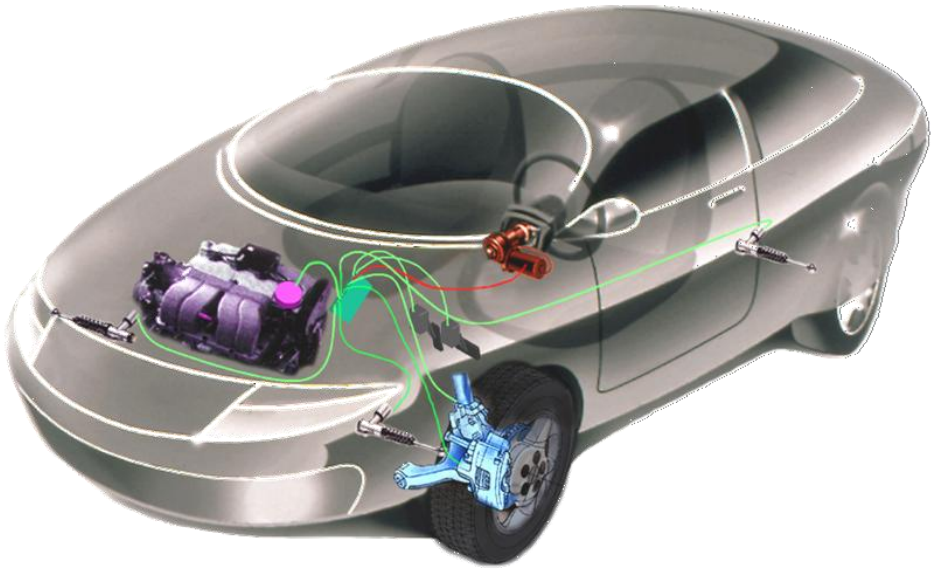
Distributed Embedded Systems

- **Consist of several heterogeneous processing elements (PEs):**
  - **General-purpose processors (GPPs), Application specific instruction processor (ASIPs), ASICs, FPGAs, smart sensors, and smart actuators.**

- **These components are connected through an infrastructure of communication links (CLs).**



Important Requirements

- **Real-time behavior**
  - Ethernet fail to meet this requirement
- **Event driven communication**
  - **Polling based communication**
    - **Very predictable, suitable for real-time behavior**
    - **Unsuitable for emergency messages**
- **Scalability**
  - **New PEs can be added easily**

CSMA/CD VS. CSMA/CA

- **CSMA/CD**
  - **carrier-sense multiple access/collision detect**
    - **cannot be used when real-time constraints have to be met.**
- **CSMA/CA**
  - **Communication media are allocated to communication partners during arbitration phases, which follow communication phases.**
  - **Suitable for Real-Time systems**

Example: Controller Area Network (CAN)

- Developed in 1981 by Bosch and Intel for connecting controllers and peripherals.
- Popular in the automotive industry.
  - It allows the replacement of a large amount of wires by a single bus.
- CAN components are relatively cheap and are therefore also used in other areas such as smart homes.

CAN Properties

- **Differential signaling with twisted pairs**
- **Arbitration using CSMA/CA**
- **Throughput between 10kbit/s and 1Mbit/s**
- **Low and high-priority signals**
- **Maximum latency of 134 µs for high priority signals**
- **Coding of signals similar to that of serial (RS-232) lines of PCs, with modifications for differential signaling.**