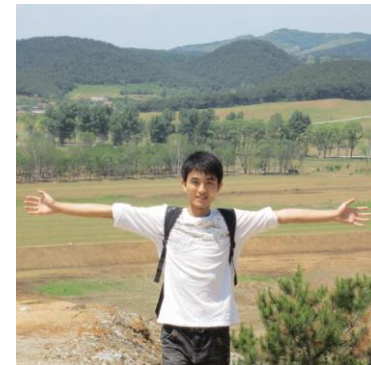


# Real Time Systems

-- 5 & 10 credits



- Lecturers
  - Pontus Ekberg: 1237, email: [pontus.ekberg@it.uu.se](mailto:pontus.ekberg@it.uu.se)
  - Wang Yi, office: 1235, email: [yi@it.uu.se](mailto:yi@it.uu.se)
- Assistants
  - Jakaria Abdullah, office: 1236, [jakaria.abdullah@it.uu.se](mailto:jakaria.abdullah@it.uu.se)
  - Gaoyang Dai, office: 1218, [gaoyang.dai@it.uu.se](mailto:gaoyang.dai@it.uu.se)



# Wiki's definition

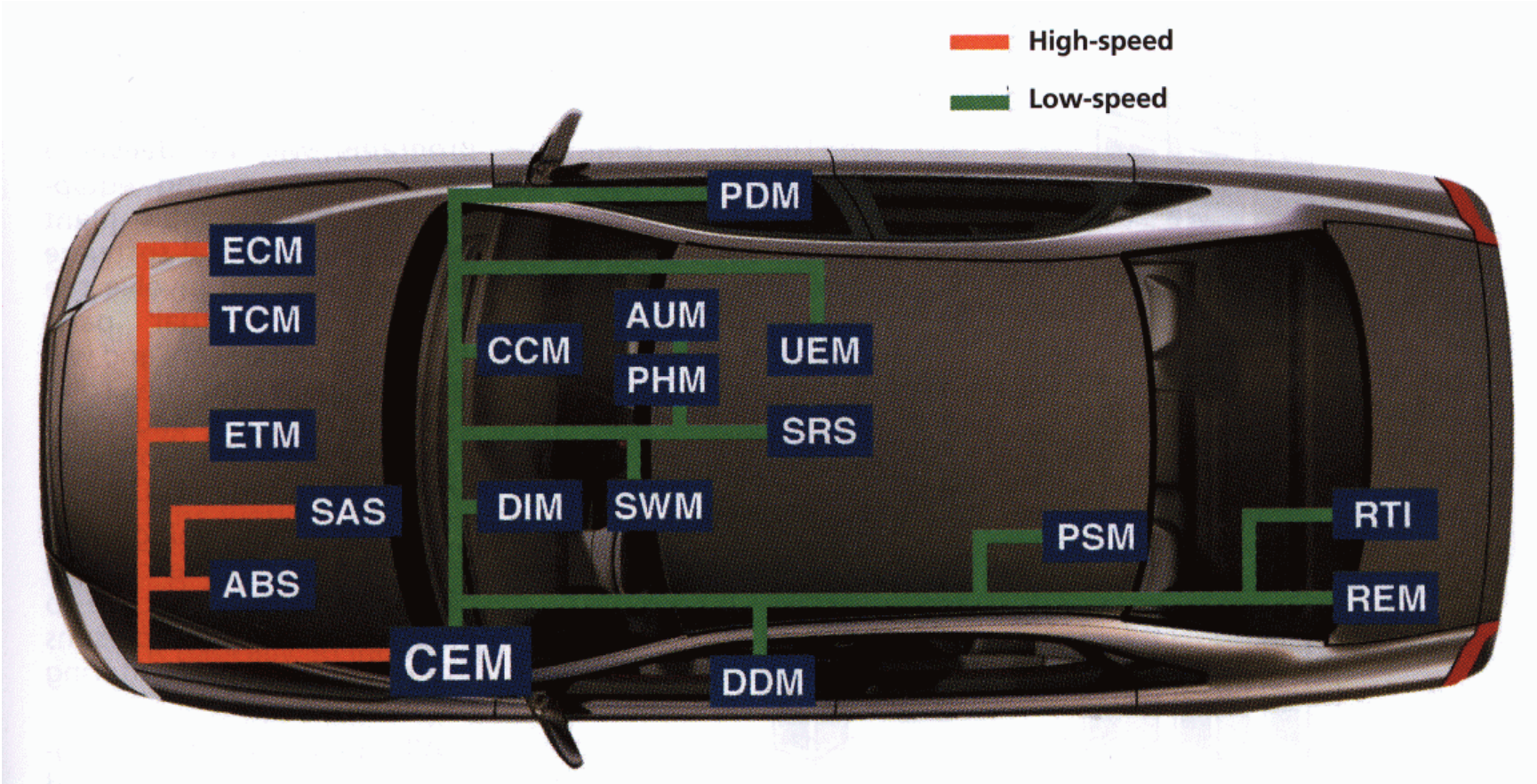
Real time systems will guarantee to give a result within a specified time --- Wiki

“Many” Real-Time Systems  
also known as “Embedded Systems”

# A Real-Time System

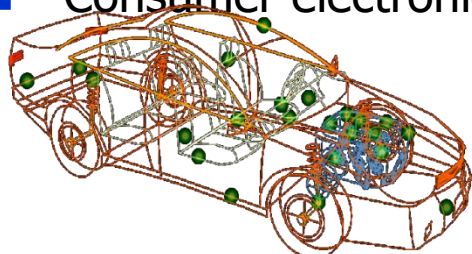


65-70 ECU's/micro-processors in some model of S80



# Real-Time/Embedded Systems = Computer Systems hidden in technical products

- Medical devices
- Automotive/Volvo
- Robotics/ABB
- Trains/Bambardier
- Flight control/SAAB
- Plant control/ABB
- Telecomm/Ericsson
- Consumer electronics/Electrolux



Over 99% of all computers produced in the world are embedded systems

**Main Goal** of this course:

Study Techniques for constructing  
**Real-Time Systems** to make sure:

- **no bug**
- **no stop**
- **no waste (of resources)**

# Main Topics

(blue=5hp, + red=10hp)

- Real-Time Operating Systems
  - What are the differences with General purpose OS?
- Real Time Programming (Languages)
  - What are the differences with general computing?
- Real-Time Scheduling and Analysis
  - What is the execution time/response time of a program?
- Distributed Systems and Real-Time Communication
  - What is the transmission delay of a message?
- Workload Models (advanced topic)
  - Graph-based task models
- Multiprocessor real-time systems (advanced topic)
  - Multicore processors
- Design and Validation (advanced topic)
  - Modeling and verification



# Lab assignments & Software

(blue=5hp, +red=10hp)

- Real Time Programming I (Ada)
- Response Time Analysis (FpsCal)
- Real-Time Programming II (Ada/OS Kernel, Lego)
- Modeling and Analysis (UPPAAL)

# Course Form

- Lectures
- Lab assignments
- **Playing with Legos! (the 2nd assignment)**



- Examination
  - assignments and
  - final written exam (a subset of problems for 5-credits)



# Literature

- On-line materials (slides for lectures)
- Real Time Systems, J.W. Liu 2000
- Further readings:
  - Real-Time Systems and Programming Languages, Alan Burns and Andy Wellings, Addison Wesley, 2001.
  - Hard Real Time Computing Systems - Predictable Scheduling Algorithms and Applications, Giorgio Buttazzo, Springer, 2005.

# Prerequisites

- **Basic** understanding of Prog. Languages e.g. C
- **Basic** understanding of Computer Architecture.
- **Basic** understanding of Operating Systems

# M.Sc Program in Embedded System: Overview

