Real Time Systems

Aug 27 – Oct 19, 2007

Wang Yi, ”google Wang Yi”

Course Information

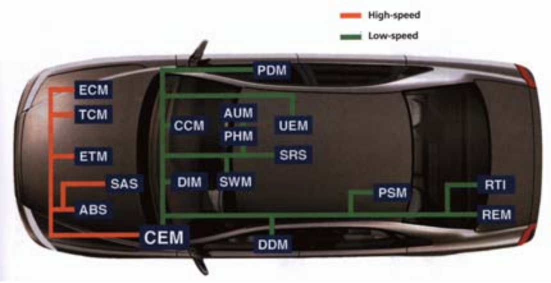
Unfortunately, the course starts at 8.15 ☹ on Monday, Aug. 27

What are ”Real-Time Systems”?

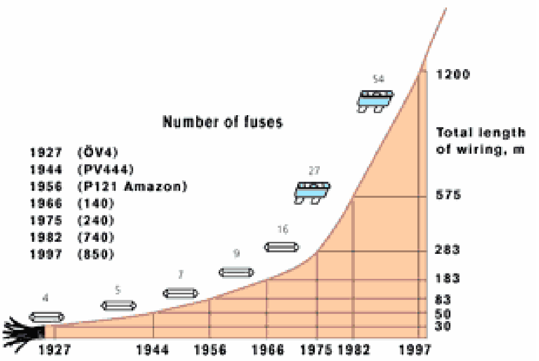
An Example Real-Time System

65-70 ECU’s/micro-processors in the newest S80

Upto 30-40% of the total cost of a car: control system



The Evolution of Automotive Electronics



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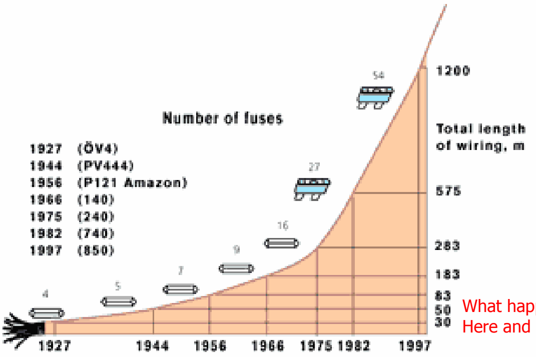
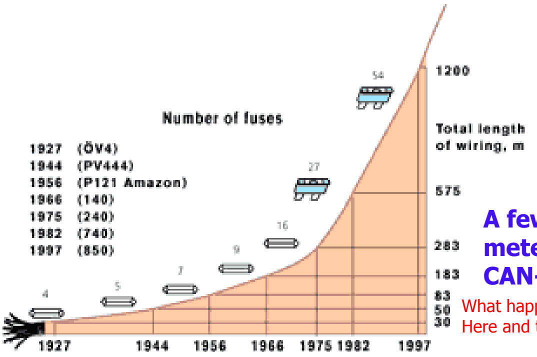


What happened
Here and then?

The Evolution of Automotive Electronics



A few meters CAN-bus!

What happened
Here and then?

A Real-Time System

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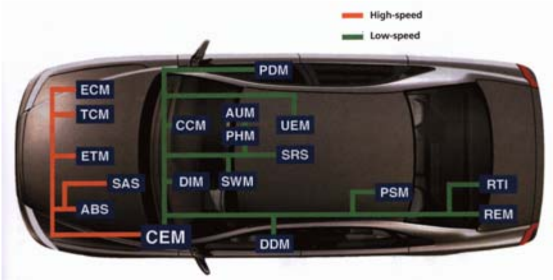

Embedded Real-Time Systems

Consume 99% of all CPUs in the world!

Computers that do not look like a computer

- **Safety-critical: Reliability = must!**
- **Mass production: a bug = milions of dollars**

Towards a "standard" definition of RTS

- A real-time system is any information processing system which has to respond to externally generated input stimuli within a finite and specified period
  - the correctness depends not only on the logical result but also the time it was delivered
  - Failure to respond is as bad as the wrong response!
- The computer is a component in a larger engineering system => EMBEDDED COMPUTER SYSTEM

Remember:

In RT systems, the correctness of computation depends not only on the results but also on the times when outputs are produced.

- Real Time =/= Fast
- Real Time =/= Time Sharing
- Real Time = just in Time (predictable)

Main Goal of this course

Study Techniques for constructing
Real-Time Software with
predictable response times

Further details …

- To understand the basic requirements of real-time systems, and how to program such systems so that the requirements are met.
- To understand how these requirements have influenced the design of real-time programming languages and real-time operating systems.
- To understand the implementation and analysis techniques which enable the requirements to be realized.

Prerequisites

- Basic understanding of C
- Basic understanding of Computer Architectures.
- Basic understanding of Operating Systems

Course Form

- Lectures
- Programming assignments (Ada, C, OS kernel)
- Playing with Legos!
- Examination
  - 4 assignments and
  - final written exam (Oct 19: 5 hours)

Software and Lab assignments

- Real Time Programming (Ada)
- Programming with RTOS (LegOS)
- Response Time Analysis (FpsCal)
- Modeling and Analysis (TIMES)

Recommended text book

- Real Time Systems, J.W. Liu 2000
- But you don’t have to buy the book if you
  - Follow the lectures
  - Understand the lecture notes
  - On-line materials (appear in real-time ☺)

People to help you!

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  - Wang Yi
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  - Email: yi@it.uu.se
- Assistant:
  - Pavel Krcal
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OUTLINE (lectures)

- Introduction
  - Characteristics of RTS
- Real Time Programming Language
  - Language support, e.g. Ada tasking
- Real Time Operating Systems (RTOS)
  - System support: scheduling, resource handling
- Design and Analysis of RT Application Software
  - Modeling and analysis
- Reliability and Fault-Tolerance
  - Fault tolerant, failure recovery, exception handling
- Distributed real time systems
  - Real Time Communication: CAN bus