Demo : Applications of the CPAL Language to Model, Simulate and Program Cyber-Physical Systems

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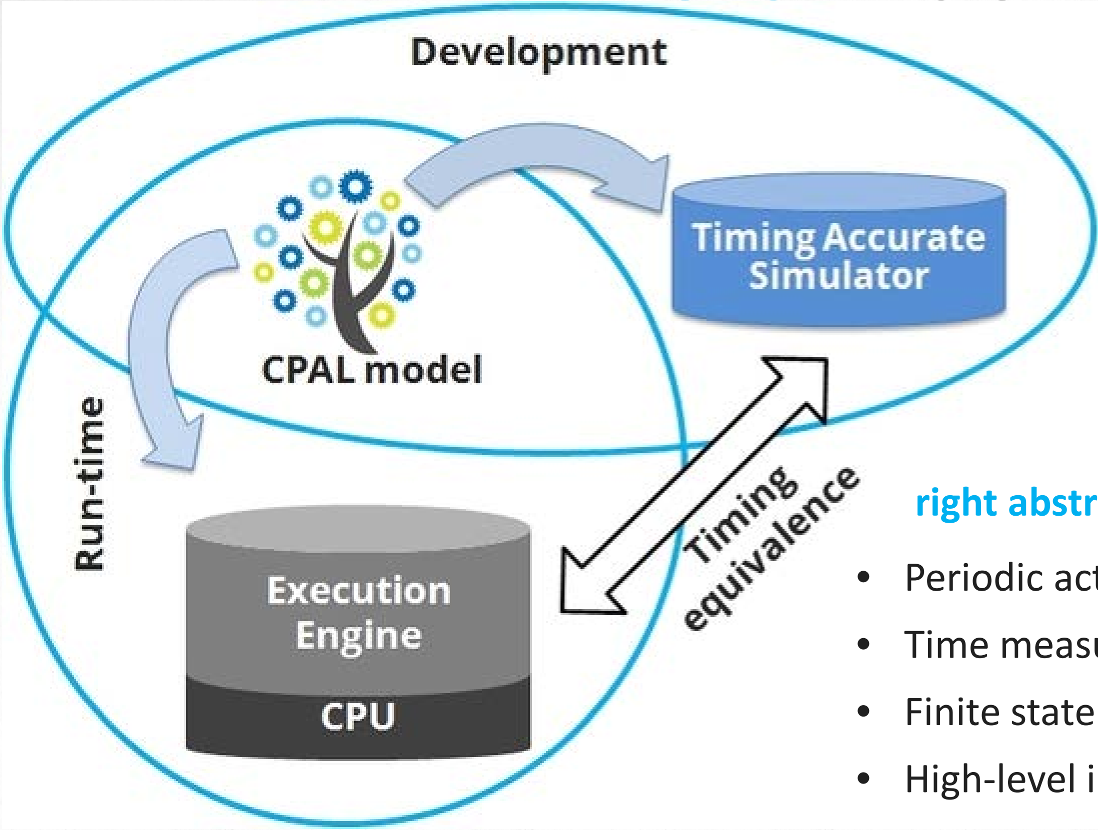
Vision behind CPAL



In CPAL current release, execution order of processes remains the same in simulation and in real-time mode

right abstractions for embedded systems :

- Periodic activities and real-time scheduling
- Time measurements and manipulation
- Finite state machines
- High-level interfaces to I/Os
- Conceived to facilitate the writing of **correct embedded code** (incl. restrictions)

"Write once, Run Anywhere" of Java does not **guarantee** anything about **timing behaviour** on different platforms

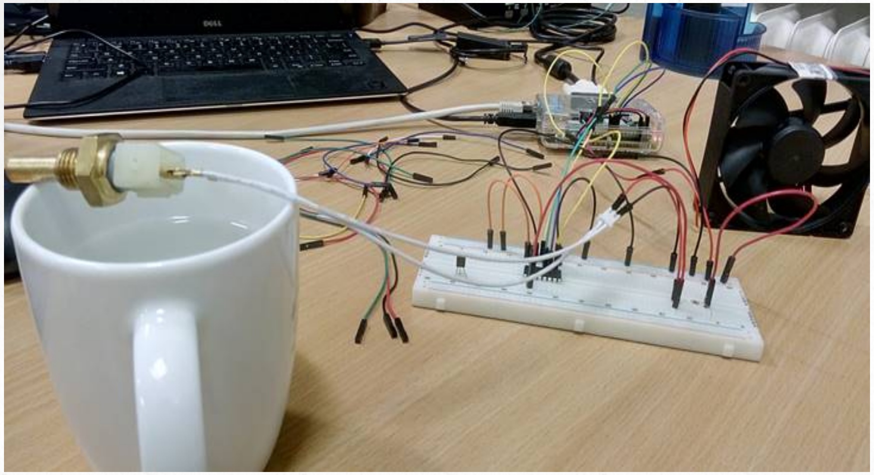
Development environments are unnecessary complex and often expensive and **Model interpretation** brings benefits

Simulating execution times

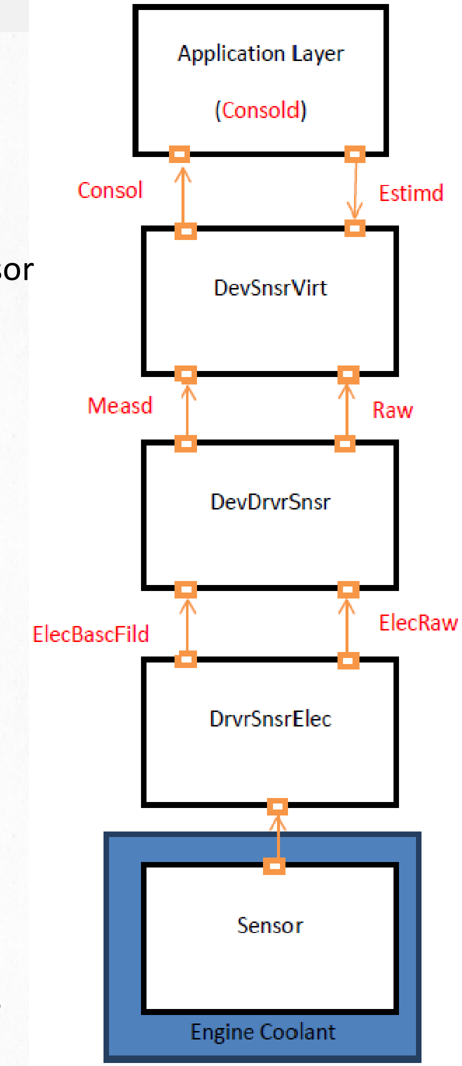
```
processdef OneShortOneLong()
{

  state State1 {
    @cpal:time {
      State1.execution_time = 20ms;
    }
  }
  on (true) to State2;
  state State2 {
    @cpal:time {
      State2.execution_time = 40ms;
    }
  }
  on (true) to State1;
}

process OneShortOneLong: aTask[60ms]();
```

Timing annotations can be derived by built-in monitoring facilities and are respected by the simulator

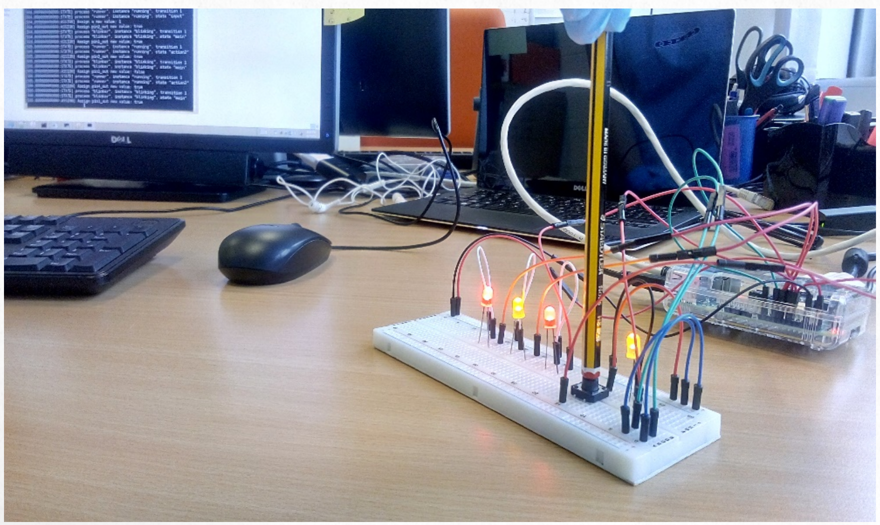
Demo # AUTOSAR Pattern – Engine function



- Raspberry Pi 2 Model B
- CPAL Raspberry Pi [Interpreter]
- Engine coolant temperature Sensor [FAE] and product [info]
- MCP 3008 – External ADC
- SPI Communication between MCP3008 and RASPI
- Script for reading MCP 3008 and pipe-out to CPAL
- CPAL model for engine coolant temperature calculation →



Demo # Event order determinism – Simulation / Real-time



- CPAL has 2 execution modes
- In simulation - Code executed in zero time – except if stated with timing annotations. Interpreter is hosted by OS
- In real-time - Code (instructions, read/write I/Os) takes time to execute –depends on the platform Interpreted, executed by bare hardware or hosted by OS

on Freescale FRDM-K64F:

- ✓ max. activation jitter: 40us
- ✓ timer interrupt: 0.6us
- ✓ context switch overhead: 2us