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Flexible Scheduling for Industrial Automation

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Platform

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- Distributed architecture
  - CAN Bus
  - Standard Ethernet HW
- Underlying RTOS
  - Mostly RT-POSIX
- Scheduling services required from OS
  - FP scheduling + immediate priority ceiling
  - Execution time budgeting
  - General purpose timers
  - Sometimes: sporadic server scheduling

Timing

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- External events:
  - periodic, sporadic, bursty, unbounded
- Internal events:
  - periodic
  - variable rate (discrete or cont. variation) within a range
- Execution time requirements
  - variable (discrete variation, continuous might be useful) within a range
  - problem: WCET estimation (usually unknown, just have rough measurements)

Timing Requirements

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- Deadlines (soft and hard with offline guarantee)
- Small output jitter in some cases
- Utilization of hard tasks is small
- Maximize utilization (rate or computation budget)
  - unused capacity reclamation
- Execution time budget enforcement

Other Requirements

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- Quality requirements
  - can be given through a single value (i.e., high-low)
- Synchronization requirements
  - events
  - mutual exclusion
- Dynamicity of requirements
  - rapid change of quality requirements
  - slower changes of other requirements
- Composability of application parts
  - independent schedulability analysis
  - contract-based
  - usually static

Memory scheduling requirements (ENEA)

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Trade-off between deadlines and length of buffers

Trade-off between memory and CPU requirements

Memory allocated to a process may be difficult to shrink

- may take long time

Issues with memory fragmentation

Need for different types of memory

- general purpose
- OS managed buffers