PROBABILISTIC PARALLEL REAL-TIME TASKS MODEL ON MULTIPROCESSOR PLATFORM

Slim

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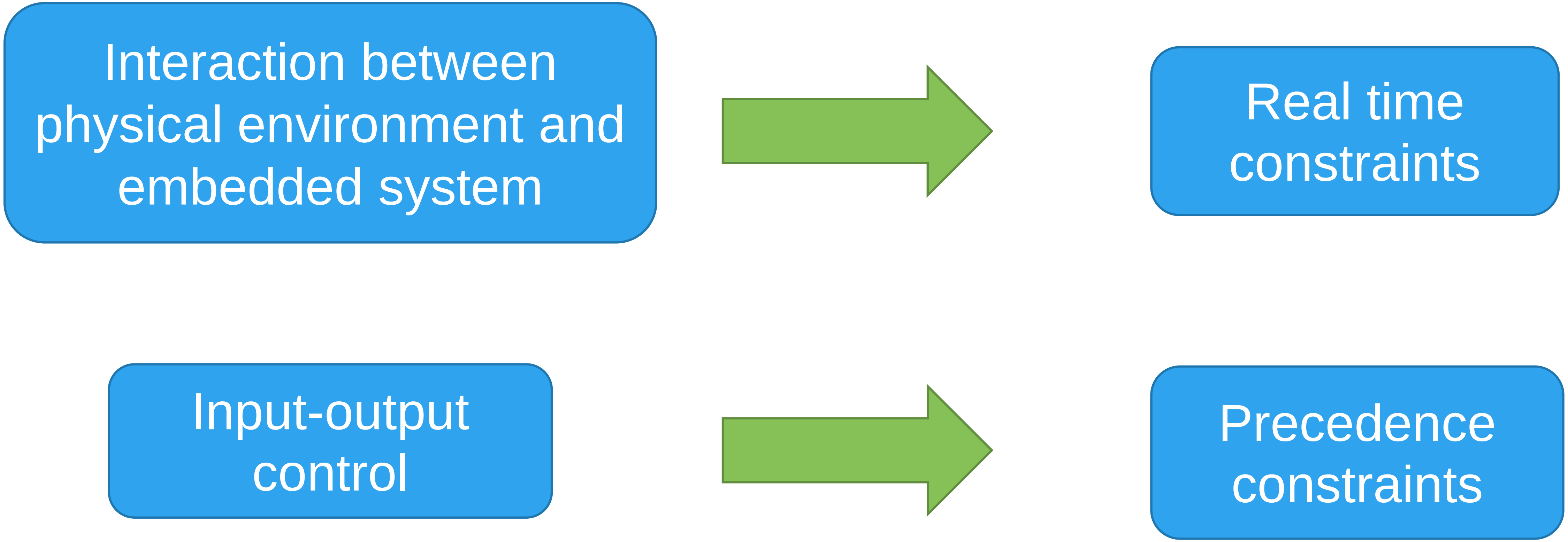
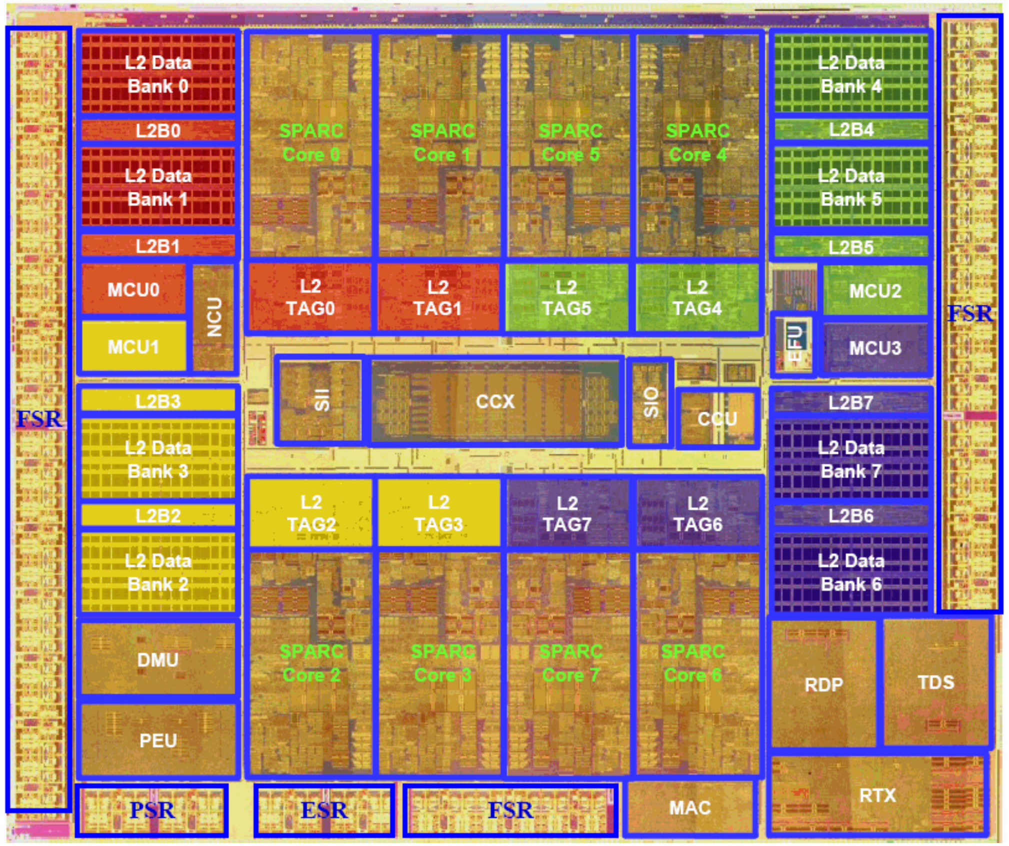
INTRODUCTION



INTRODUCTION

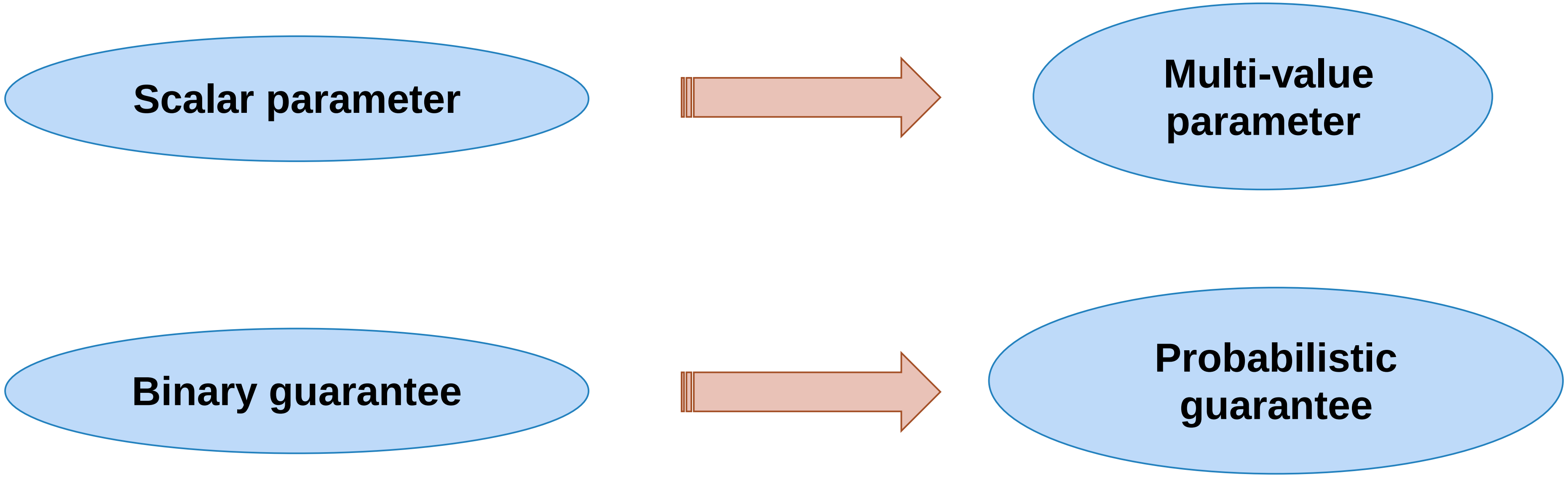
- Most hardware has complex architecture:
  - Enhance average performance
  - Introduce variability into execution time and communication delay



- Worst case analysis:
  - Pessimism
  - Oversizing / Extra cost

INTRODUCTION

➢ **new approach: Probabilistic**



OUTLINE

- Introduction
- Probabilistic Model
- Motivating Examples
- Open Problems

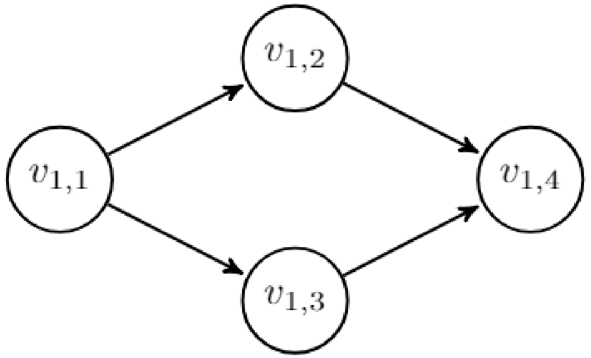
PROBABILISTIC MODEL

- n sporadic DAG Tasks.
  Each task has: n_i subtasks, O_i offset, D_i deadline, T_i inter-arrival time

Task	O_i	D_i	T_i
τ_1	0	7	7
τ_2	1	5	7
τ_3	0	6	7
τ_4	3	7	7

Example timing parameter

- subtasks related with precedence constraint (Direct Acyclic Graph)



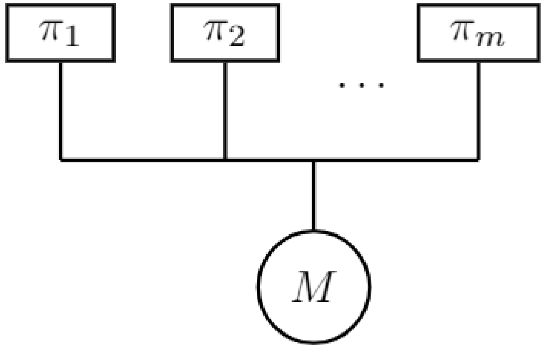
Precedence graph (DAG)

PROBABILISTIC MODEL

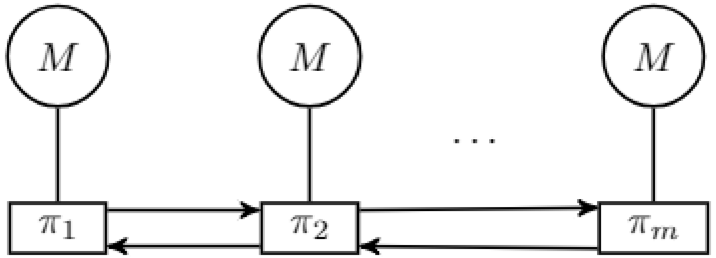
- subtask characterized by probabilistic WCET distribution (pWCET)

$$C_{i,l} = \begin{pmatrix} 2 & 3 & 8 \\ 0.5 & 0.3 & 0.2 \end{pmatrix}$$

- m uniform processors π_i with speed s_i



Multi-core with shared memory



Multi-processor communicate with messages

OUTLINE

MOTIVATING EXAMPLE: CRITICAL UAV

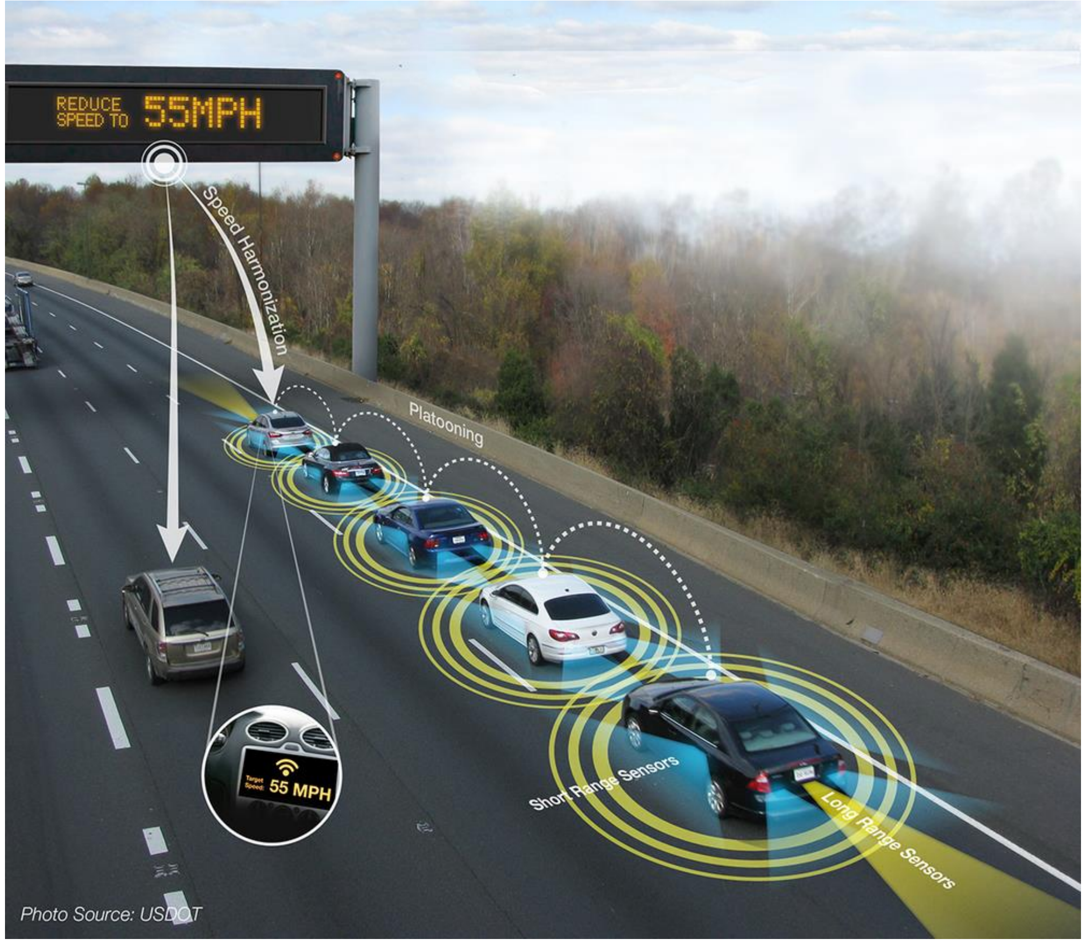
- Several tasks with temporal and precedence constraints

- Multicore platform: high variation of execution time caused by interference and complex architecture

- Execution time variation could be modeled by pWCET

MOTIVATING EXAMPLE: CAR PLATOON

- Several vehicles follow a leader and exchange information via wireless protocol (Wi-Fi)
- Distributed system: multi-processor architecture with wireless communication
- Communication delay variation could be modeled by additional subtasks in the DAG with probabilistic WCET



OUTLINE

OPEN SCHEDULING PROBLEMS

- **Problem 1:** Given subtask partitioning, how to calculate the probabilistic worst case response time (pWCRT) for each task?

- **Intuitions and difficulties:**
  - Convolution of pWCET of higher priority subtasks on the same processor.
  - How to deal with dependent subtasks executed on different processors?

OPEN SCHEDULING PROBLEMS

- **Problem 2:** Global scheduling for subtask without job migration. How to calculate the probabilistic worst case response time (pWCRT) for each task?

- **Intuitions and difficulties:**
  - How to determine higher priority subtasks that execute on same processor?

THANK YOU FOR YOUR ATTENTION