

FAULT-TOLERANT MULTIPROCESSOR SCHEDULING

MAKING USE OF BACKUP COPY TECHNIQUE

Petr DOBIÁŠ¹ (petr.dobias@irisa.fr), Emmanuel CASSEAU¹ and Oliver SINNEN²

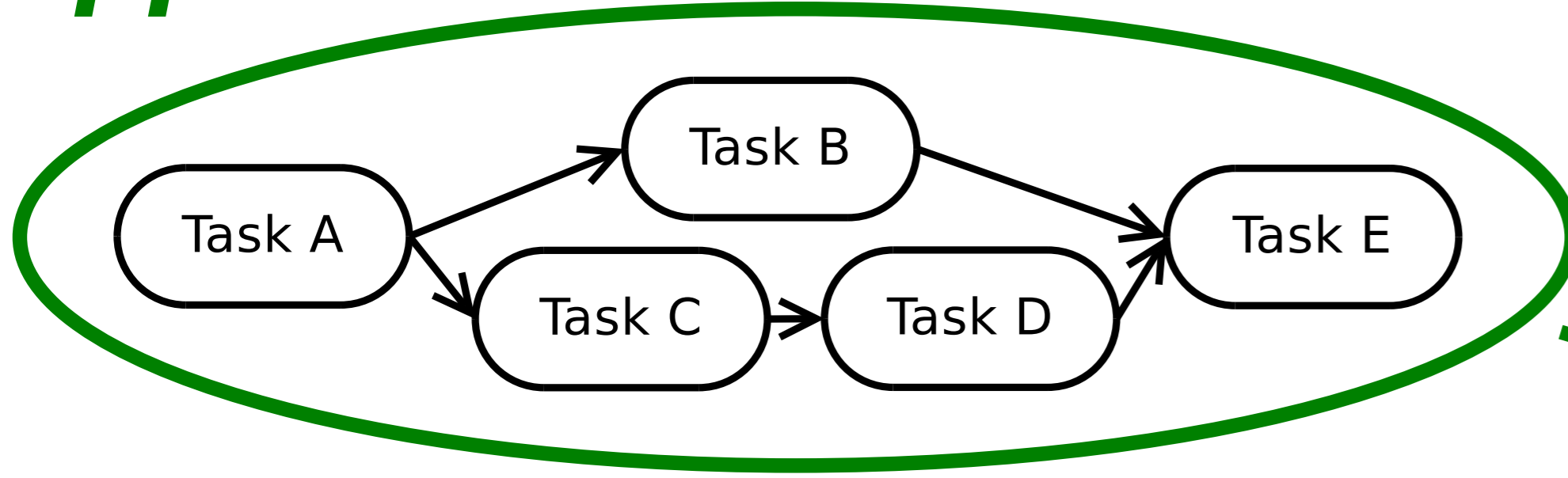
¹Univ Rennes, Inria, CNRS, IRISA, F-22305 Lannion, France

²PARC Lab, Department of Electrical and Computer Engineering, University of Auckland, Auckland, New Zealand

Aim: Development of a run-time, self-adaptive and fault-tolerant scheduling algorithm for Multiprocessor System-on-Chip

Keywords: Fault-tolerant design, Mapping and scheduling, Multiprocessor platform

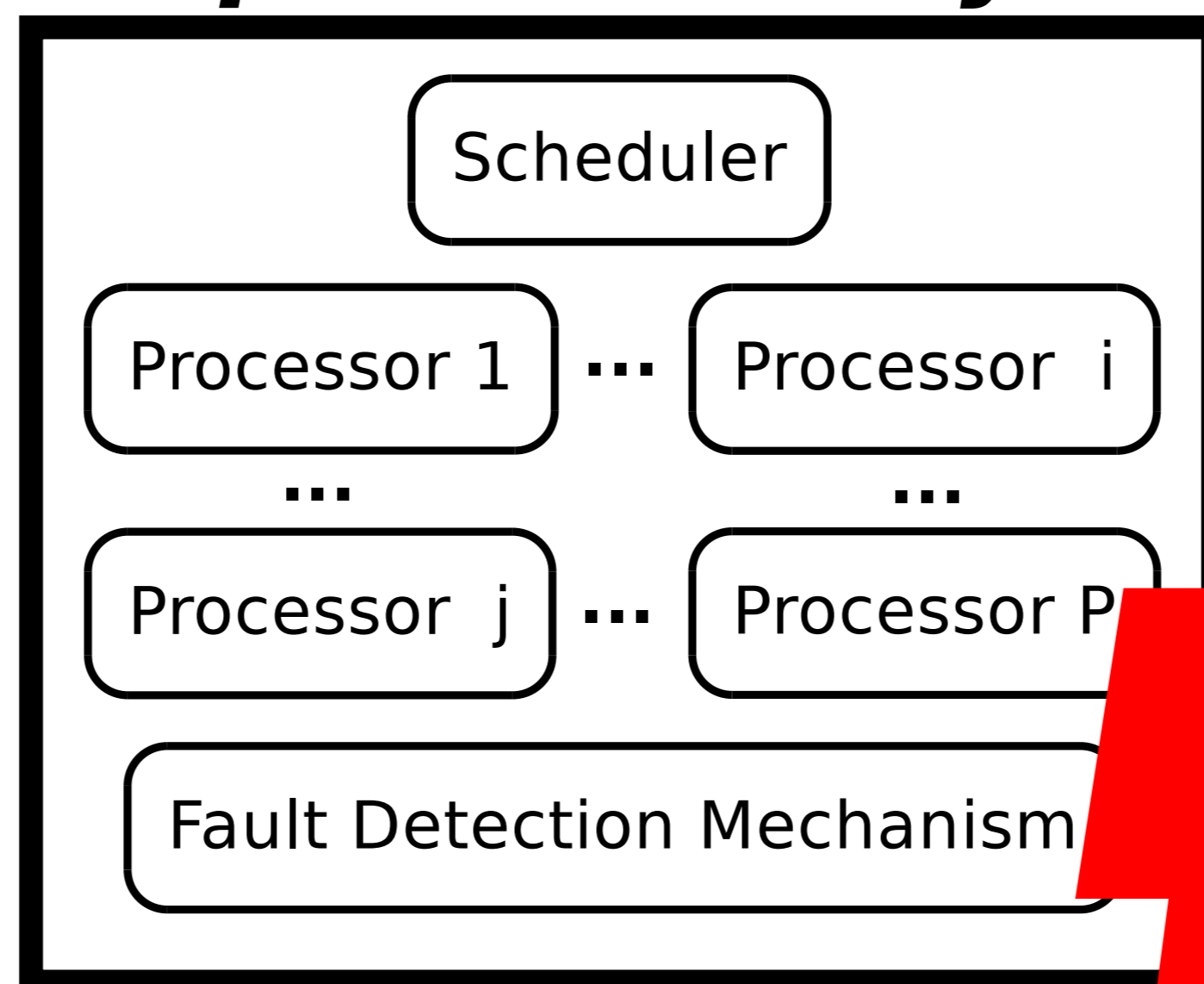
Applications



Constraints

- Small area
- High performance
- Low power consumption
- Hard real-time
- ...

Multiprocessor System



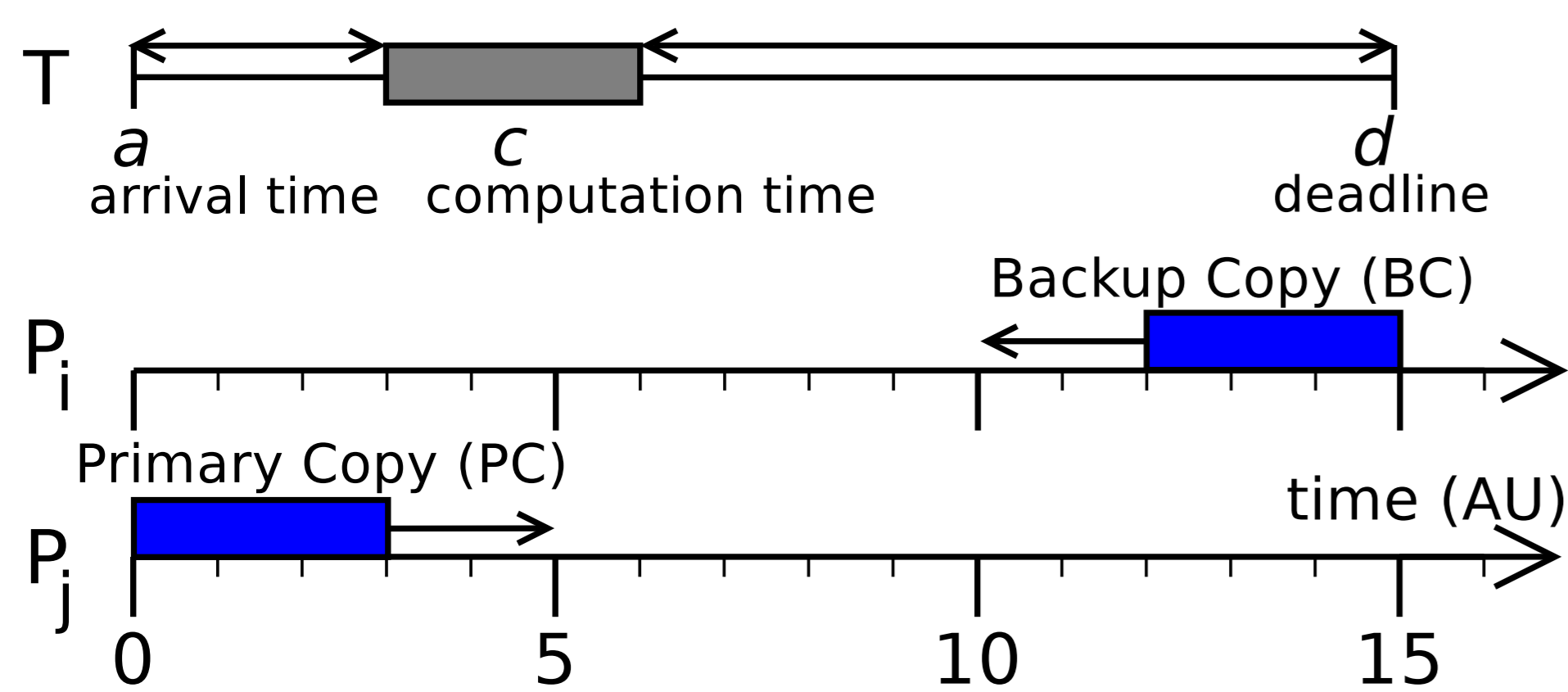
Issues

- Trade-off:
 - Parallel computing
 - Spatial redundancy
- Mapping and scheduling control
- Fault detection and recovery

Faults

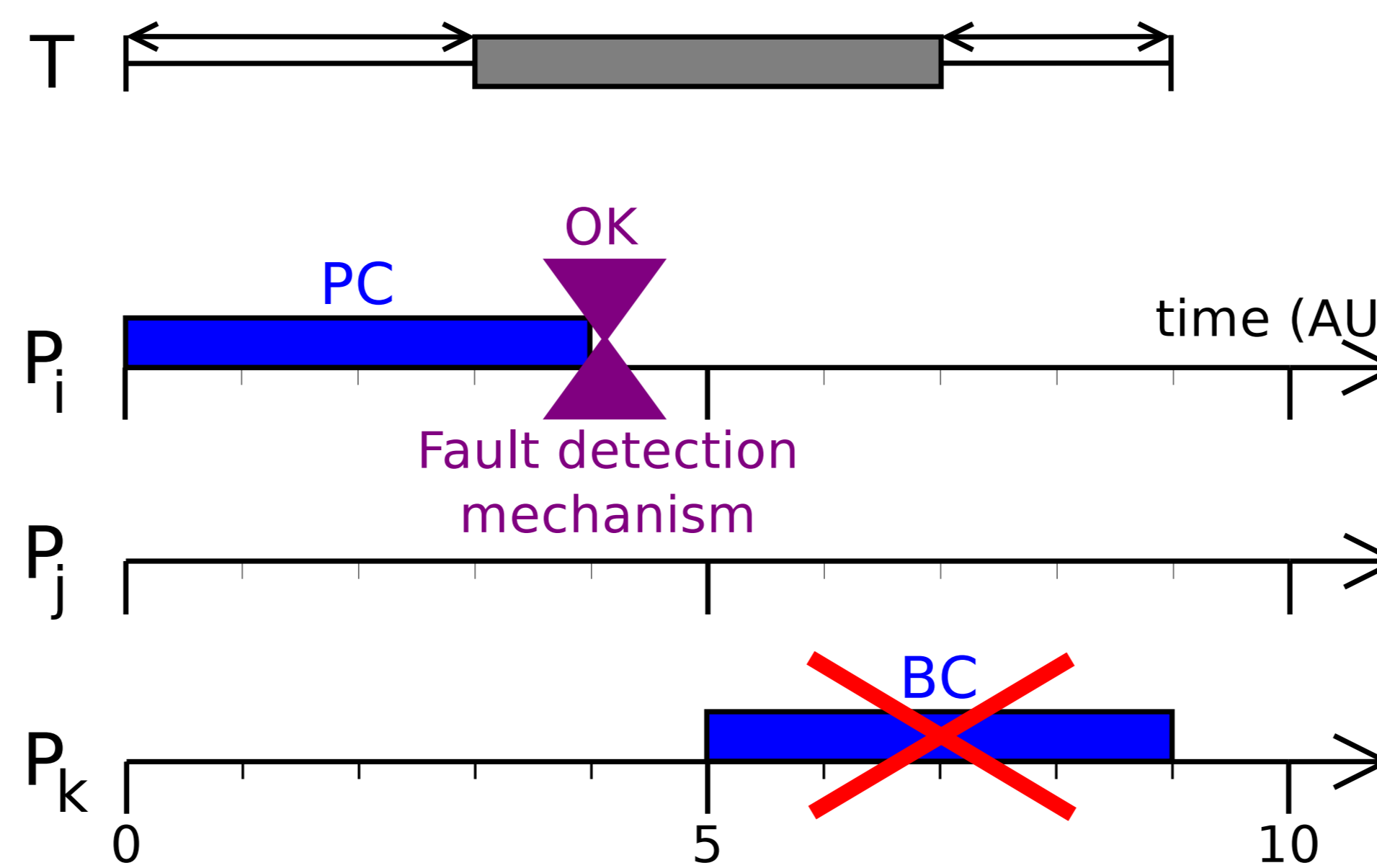
PRINCIPLE OF MAPPING AND SCHEDULING BASED ON THE PRIMARY/BACKUP APPROACH

Baseline Technique

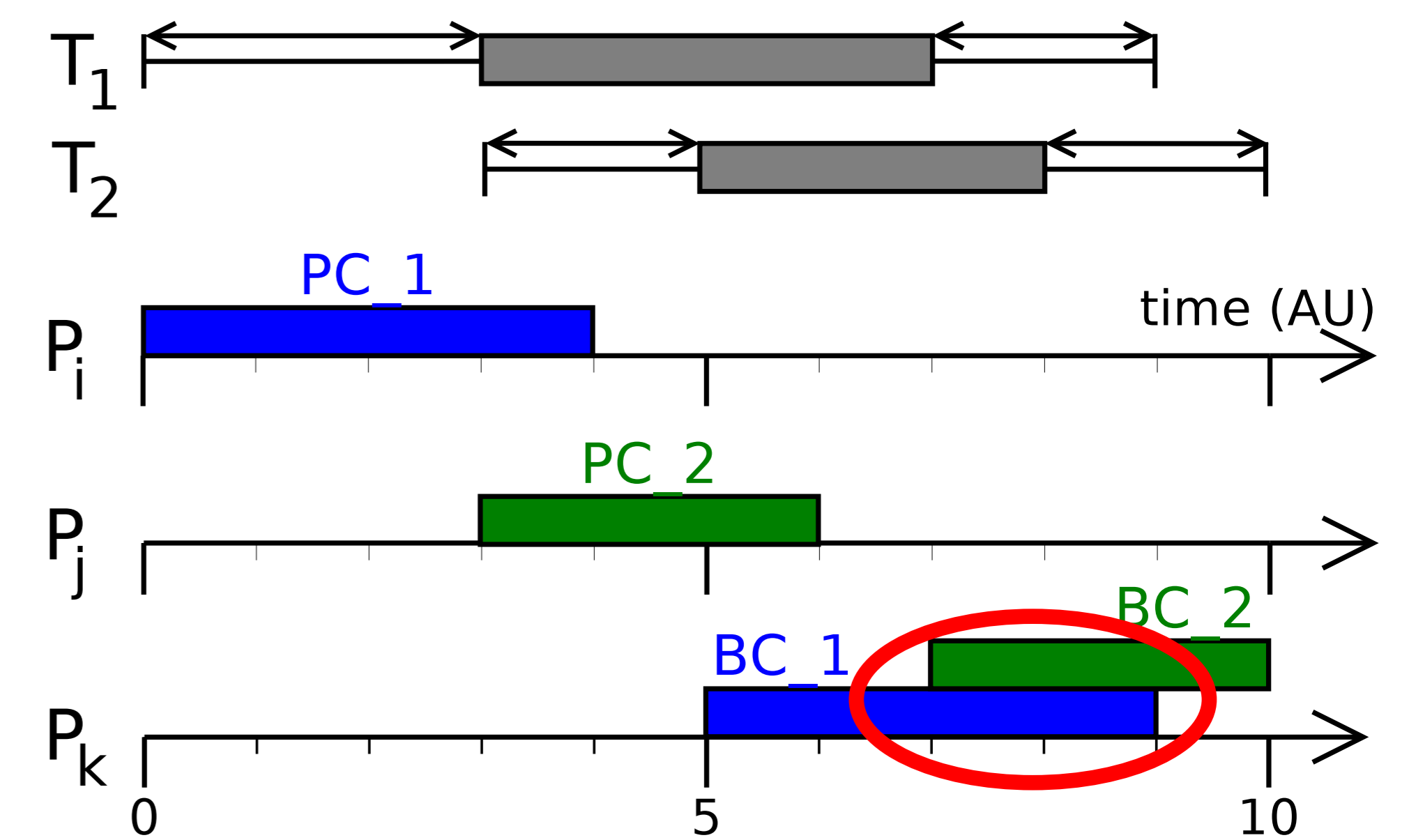


- ▶ Primary copy scheduled ASAP
- ▶ Backup copy scheduled ALAP

Backup Deallocation



Backup Overloading



SIMULATION & TASK PARAMETERS

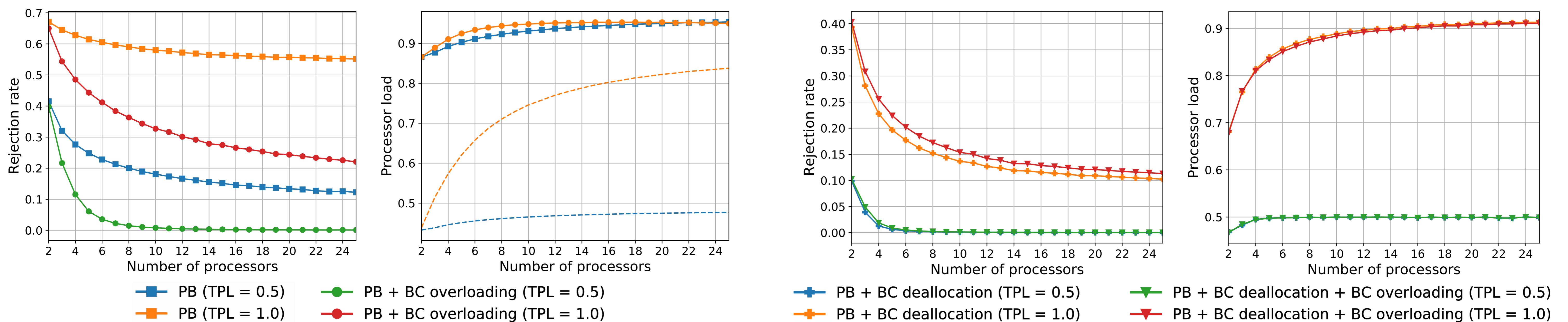
Simulation parameter	Min	Max
Number of processors: P	2	25
Targeted processor load: TPL	0.5	1.0

Task attribute	Distribution	Min	Max
Arrival time a (AU)	Poisson	-	-
Computation time c (AU)	Uniform	1	20
Deadline d (AU)	Uniform	$a + 2c$	$a + 5c$

Interarrival time

- ▶ Poisson parameter to generate task arrival times
- ▶ $\lambda = \frac{\text{average computation time}}{TPL \cdot P}$

RESULTS: REJECTION RATE AND PROCESSOR LOAD AS A FUNCTION OF THE NUMBER OF PROCESSORS



S. Ghosh, R. Melhem and D. Mossé, "Fault-Tolerance through Scheduling of Aperiodic Tasks in Hard Real-Time Multiprocessor Systems", *IEEE Transactions on Parallel and Distributed Systems*, vol. 8, no. 3, pp. 272–284, 1997
 A. Naithani, S. Eyerhan and L. Eeckhout, "Reliability-Aware Scheduling on Heterogeneous Multicore Processors", *IEEE Transactions on Computers*, vol. 67, no. 6, pp. 830–846, 2018