Five problems in compositionality of real-time systems

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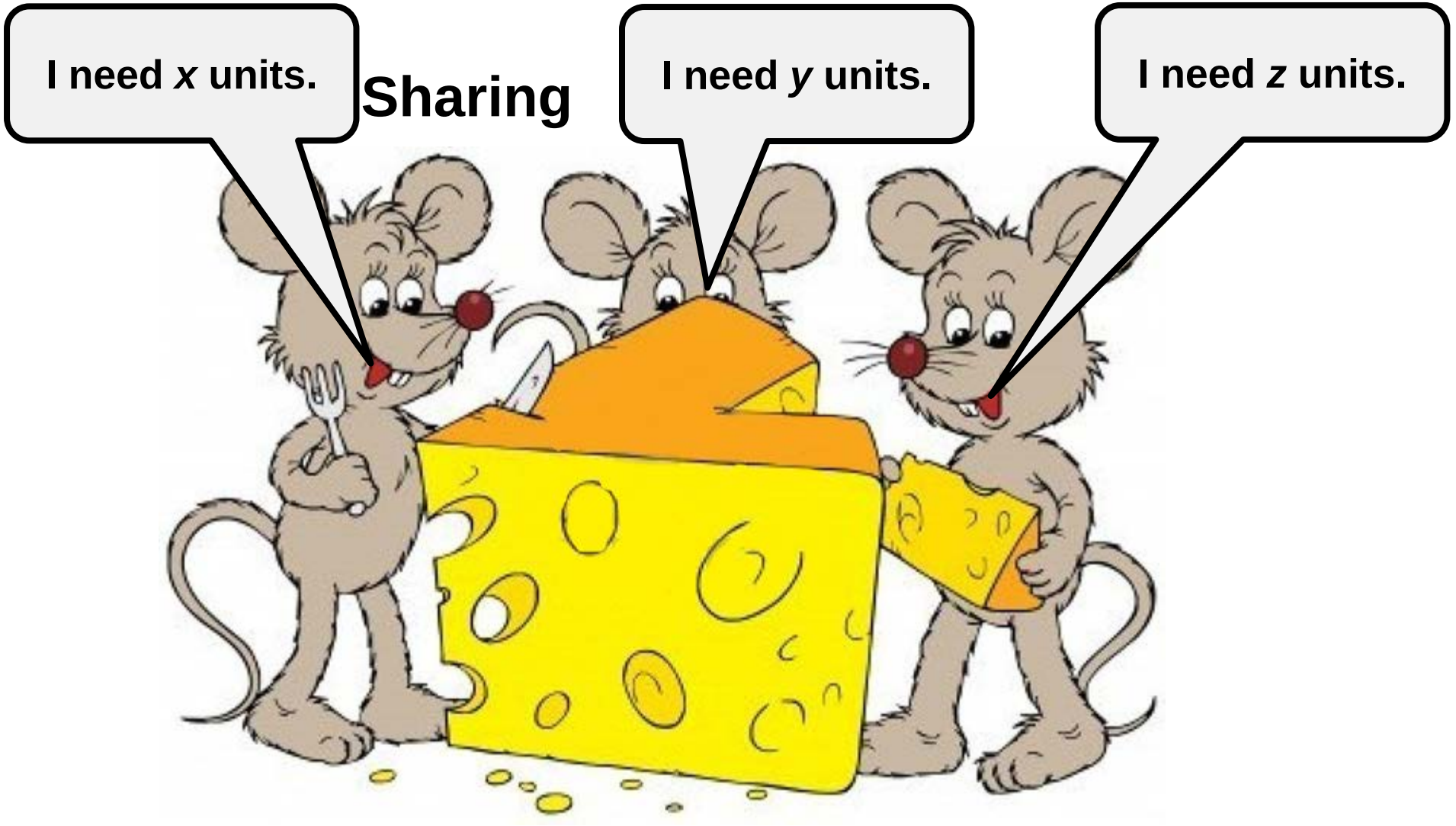
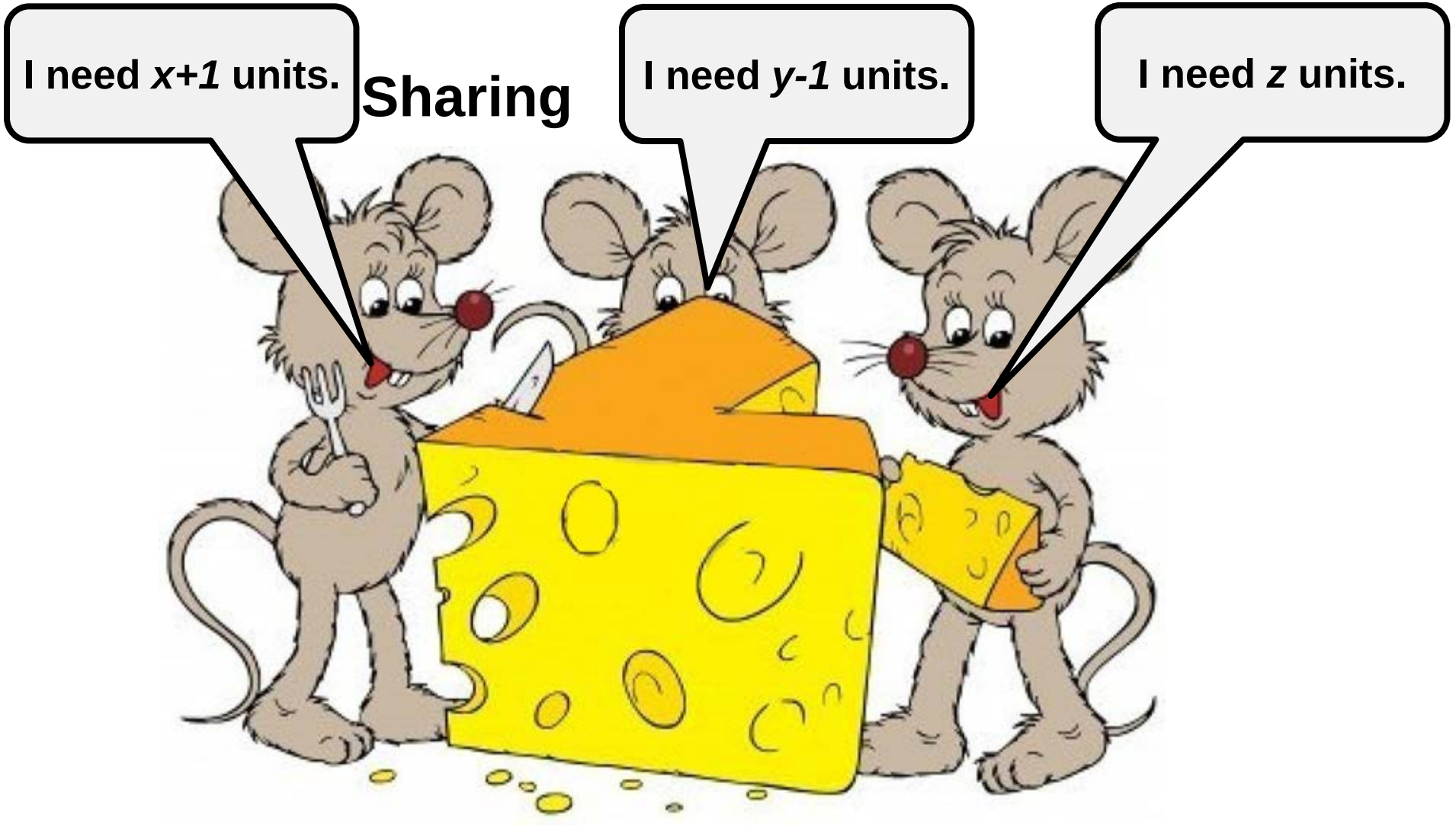
Resource Sharing

Sharing



Is there enough resource capacity so that each request can be fulfilled?

Sharing



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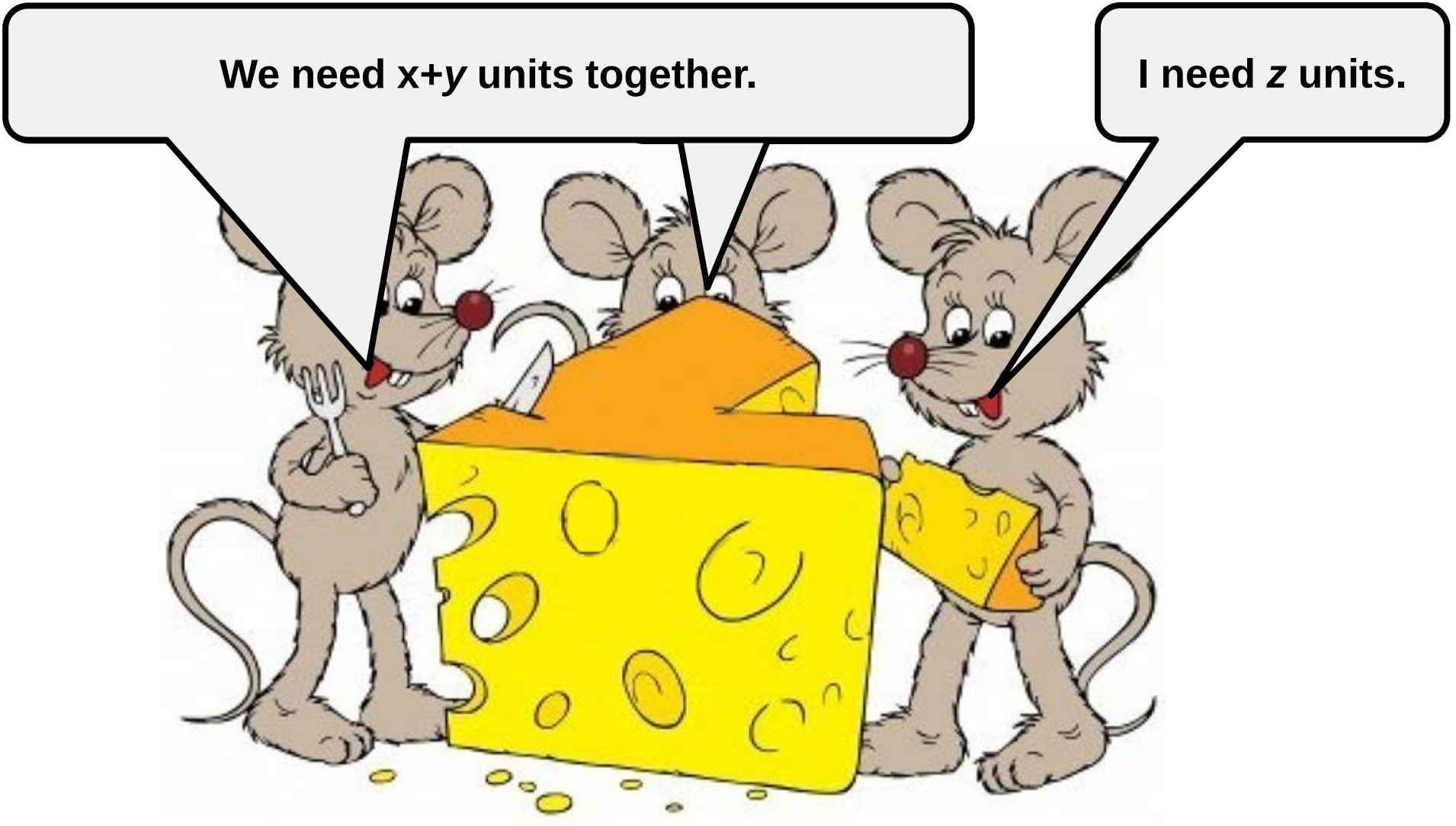

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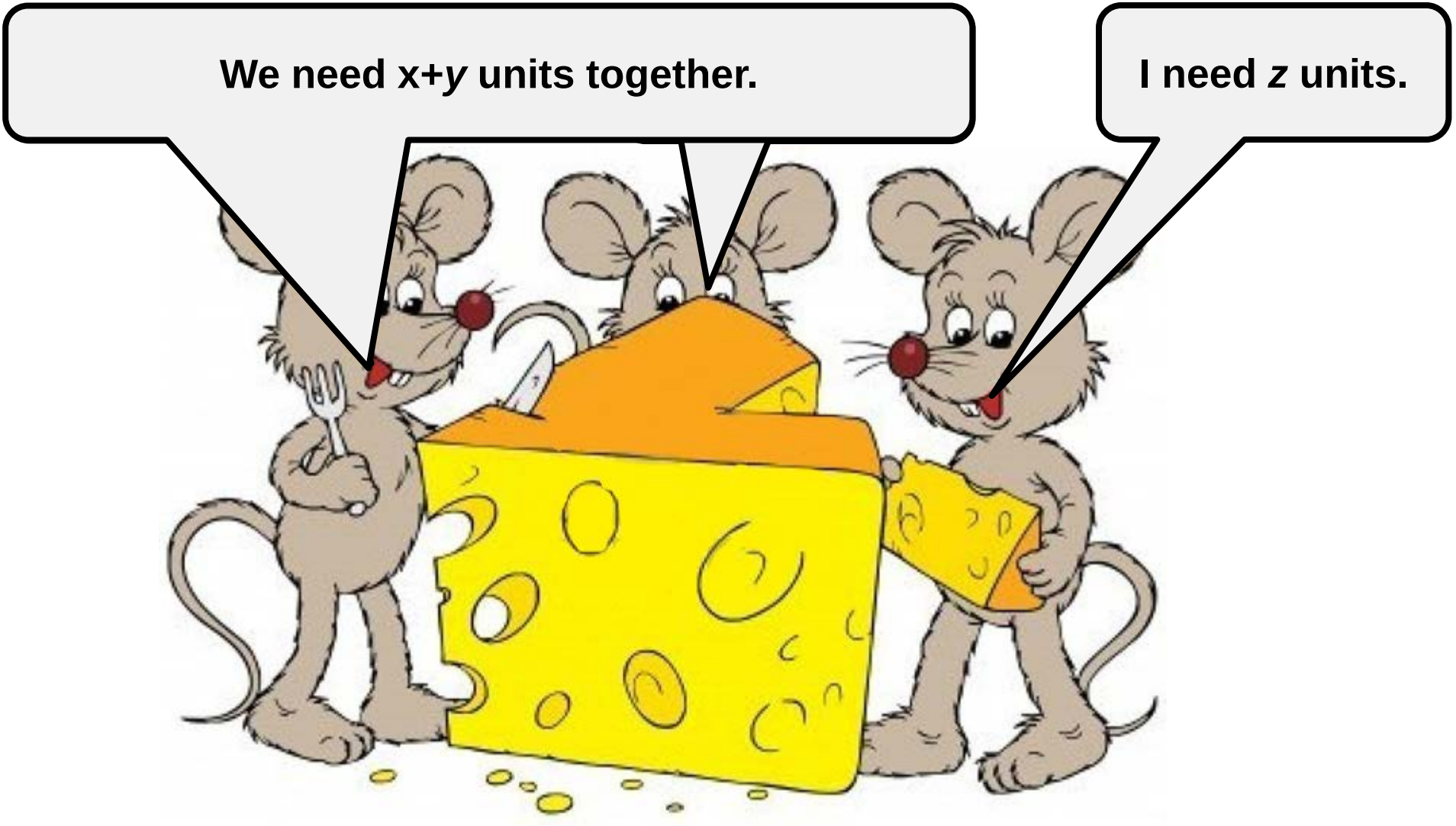


Problem 1: Create an interface (describing how much resources a subset of requestors need).

Problem 2: Design analysis techniques that take interfaces as inputs.

Outline

Interface for constrained-deadline sporadic tasks on a single processor

Interface for memory accesses

Interface for complex protocols

Interface for wireless traffic

Interface for autonomous cars

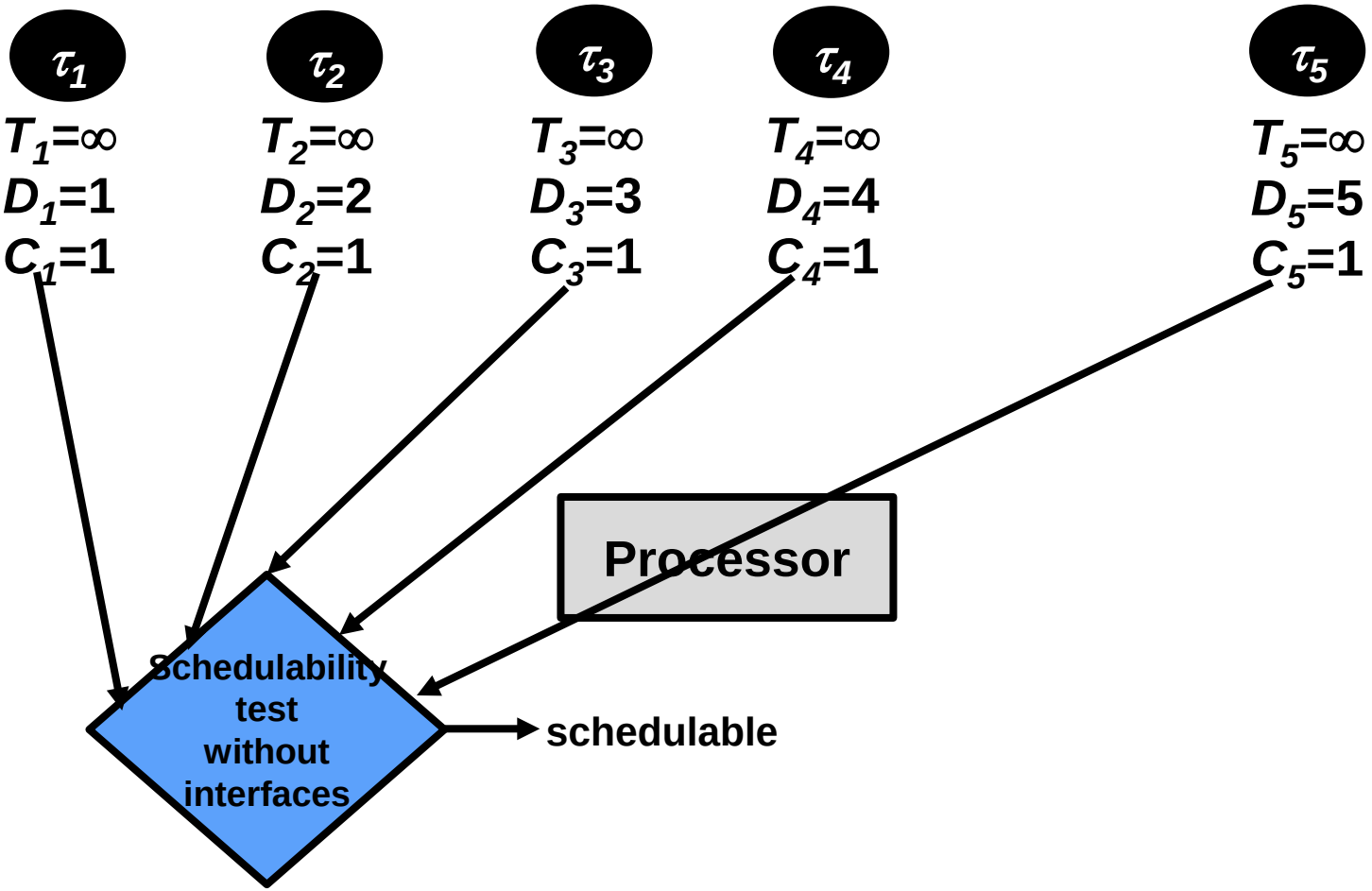
Interface for constrained-deadline sporadic tasks on a single processor

Problem context/statement

τ_1	τ_2	τ_3	τ_4	τ_5
$T_1=\infty$	$T_2=\infty$	$T_3=\infty$	$T_4=\infty$	$T_5=\infty$
$D_1=1$	$D_2=2$	$D_3=3$	$D_4=4$	$D_5=5$
$C_1=1$	$C_2=1$	$C_3=1$	$C_4=1$	$C_5=1$

Interface for constrained-deadline sporadic tasks on a single processor

Problem context/statement



Interface for constrained-deadline sporadic tasks on a single processor

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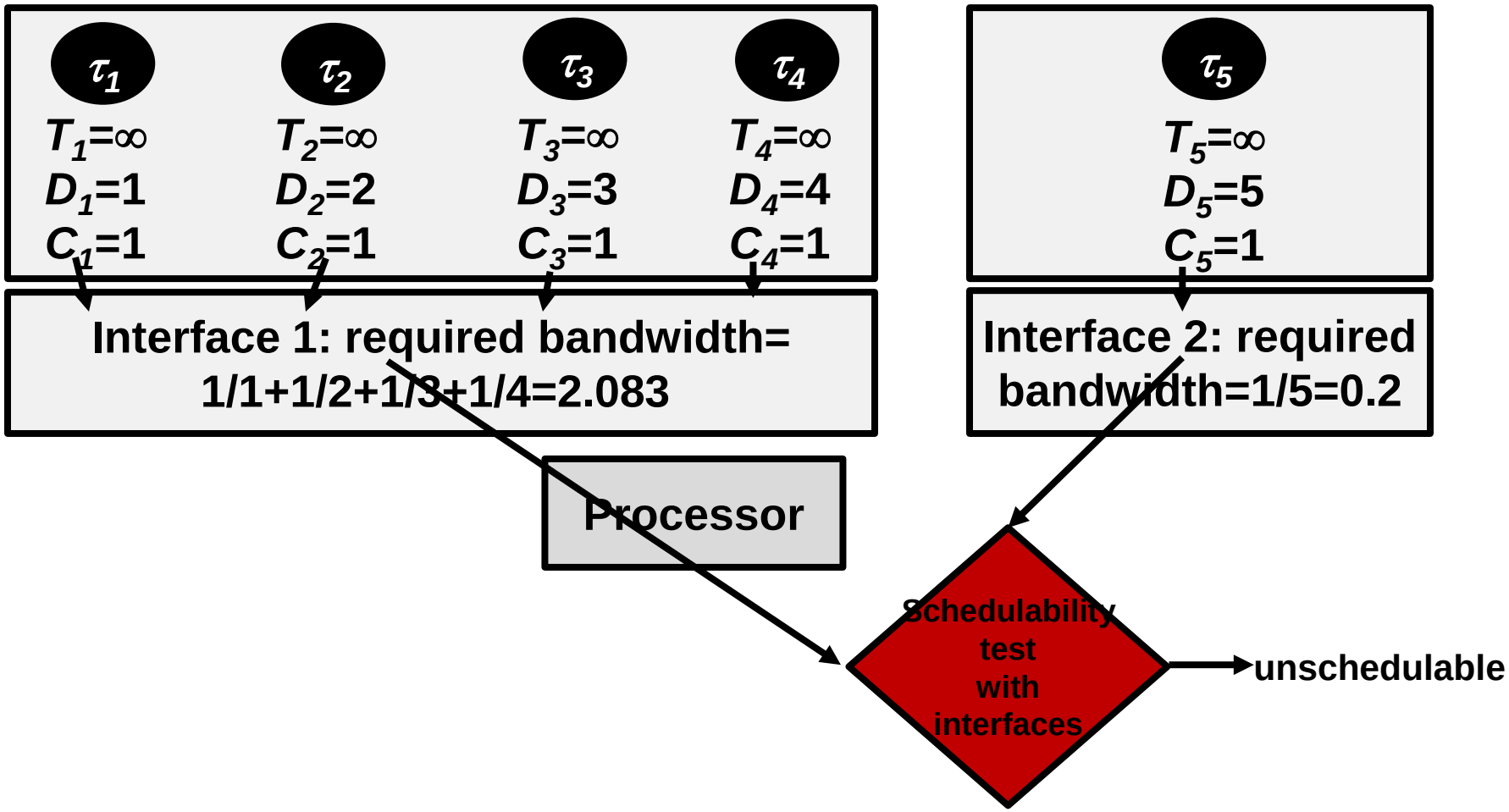
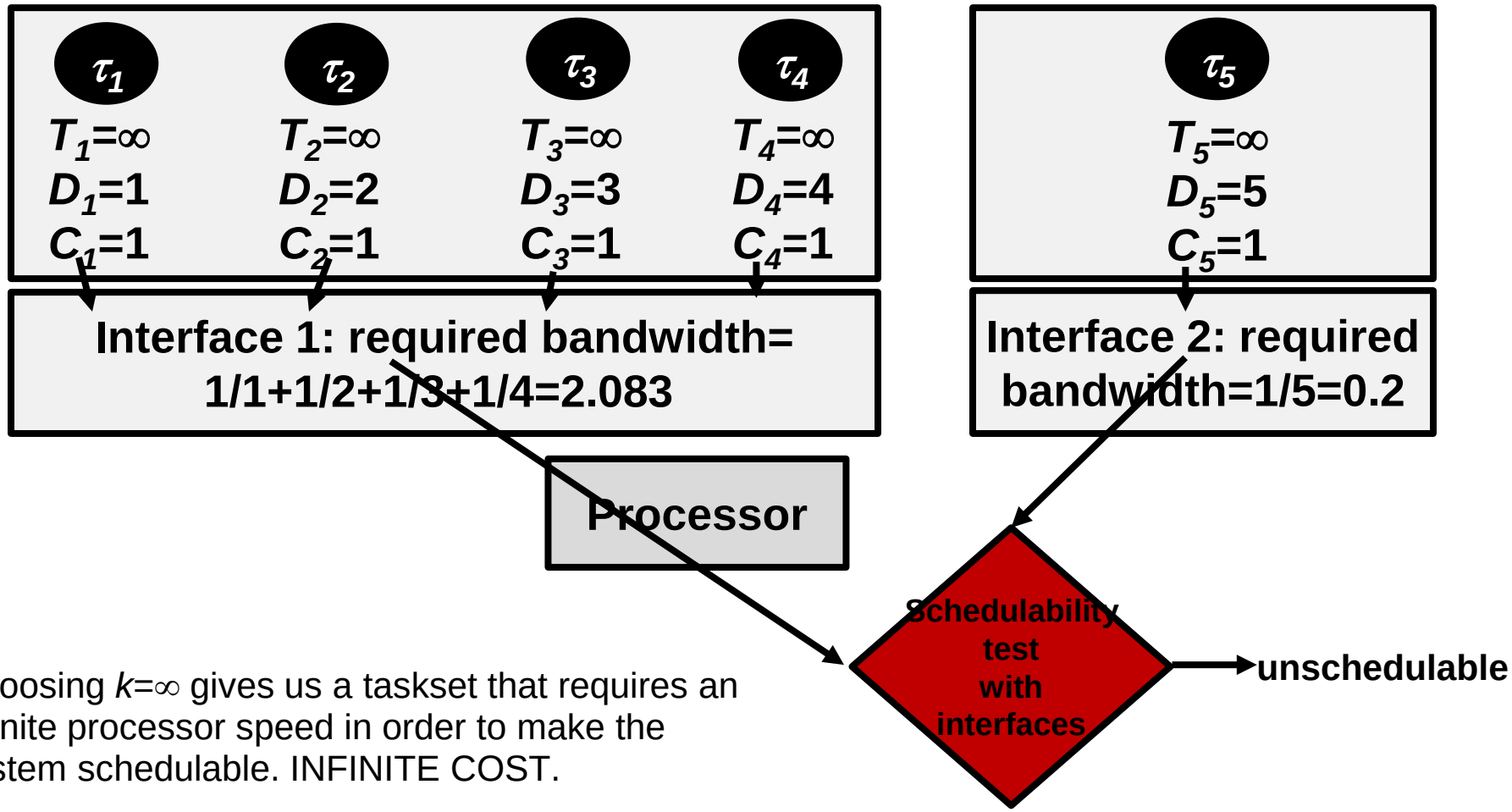


Interface for constrained-deadline sporadic tasks on a single processor

Why is it challenging?



Choosing $k=\infty$ gives us a taskset that requires an infinite processor speed in order to make the system schedulable. INFINITE COST.

Interface for constrained-deadline sporadic tasks on a single processor

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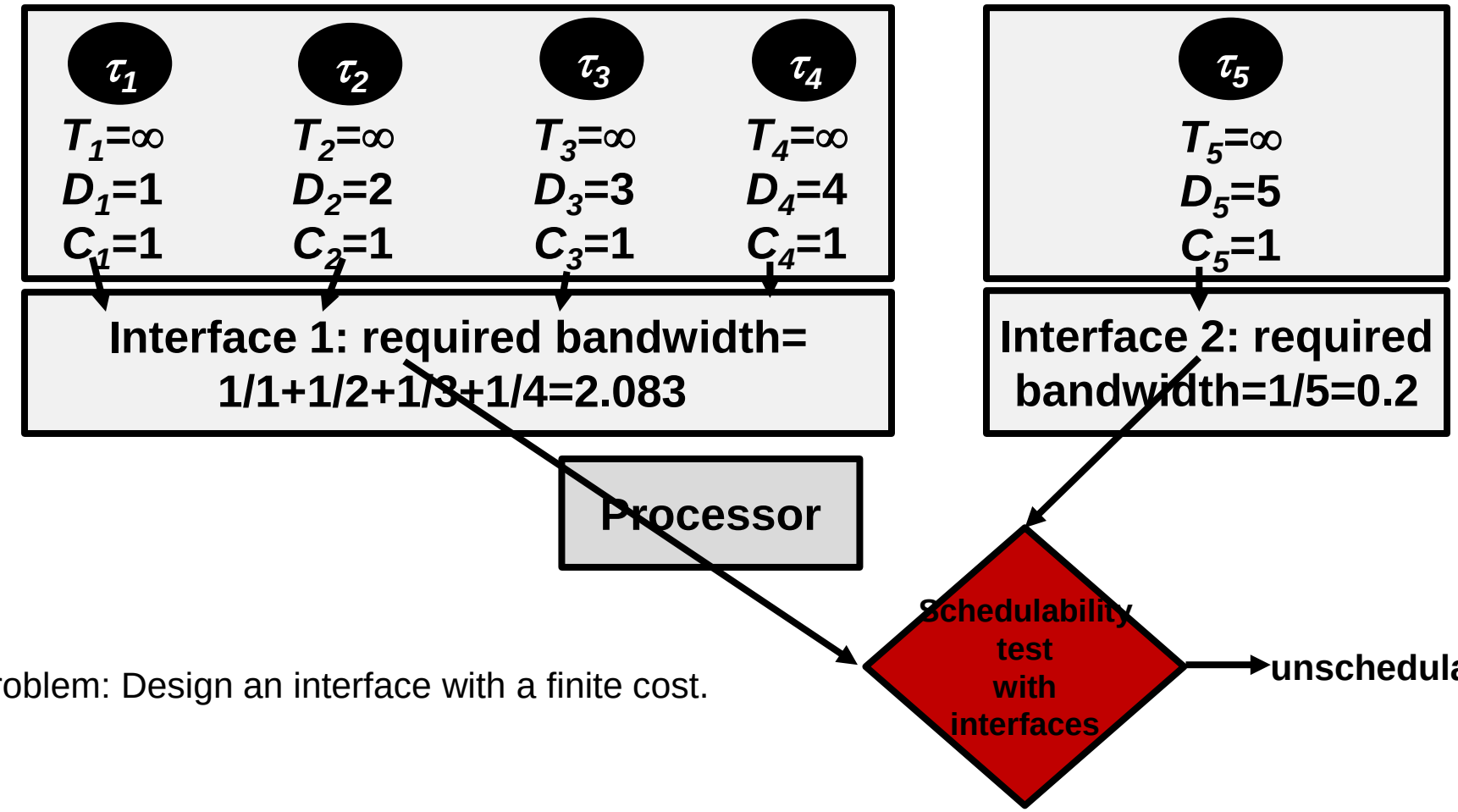
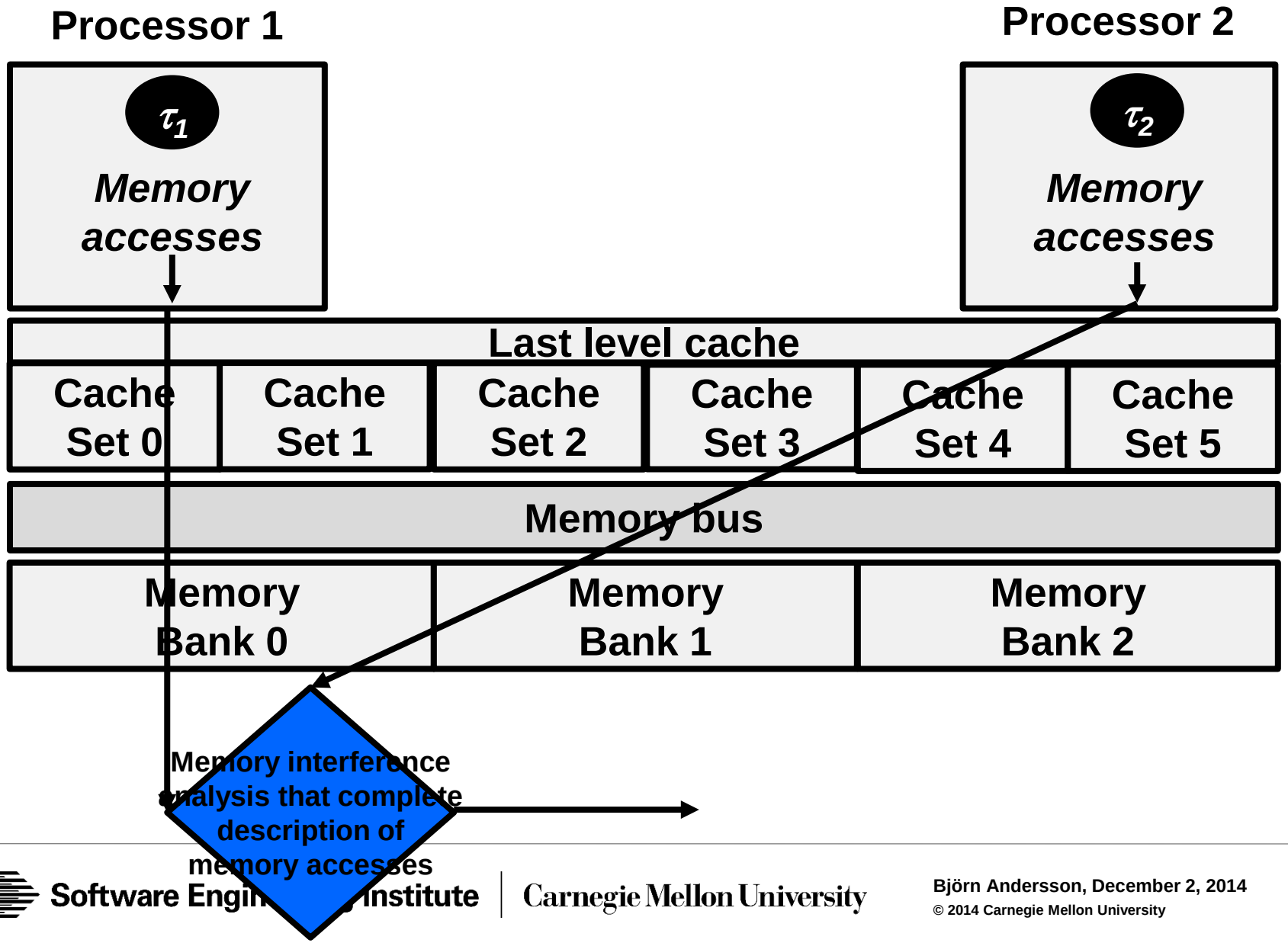
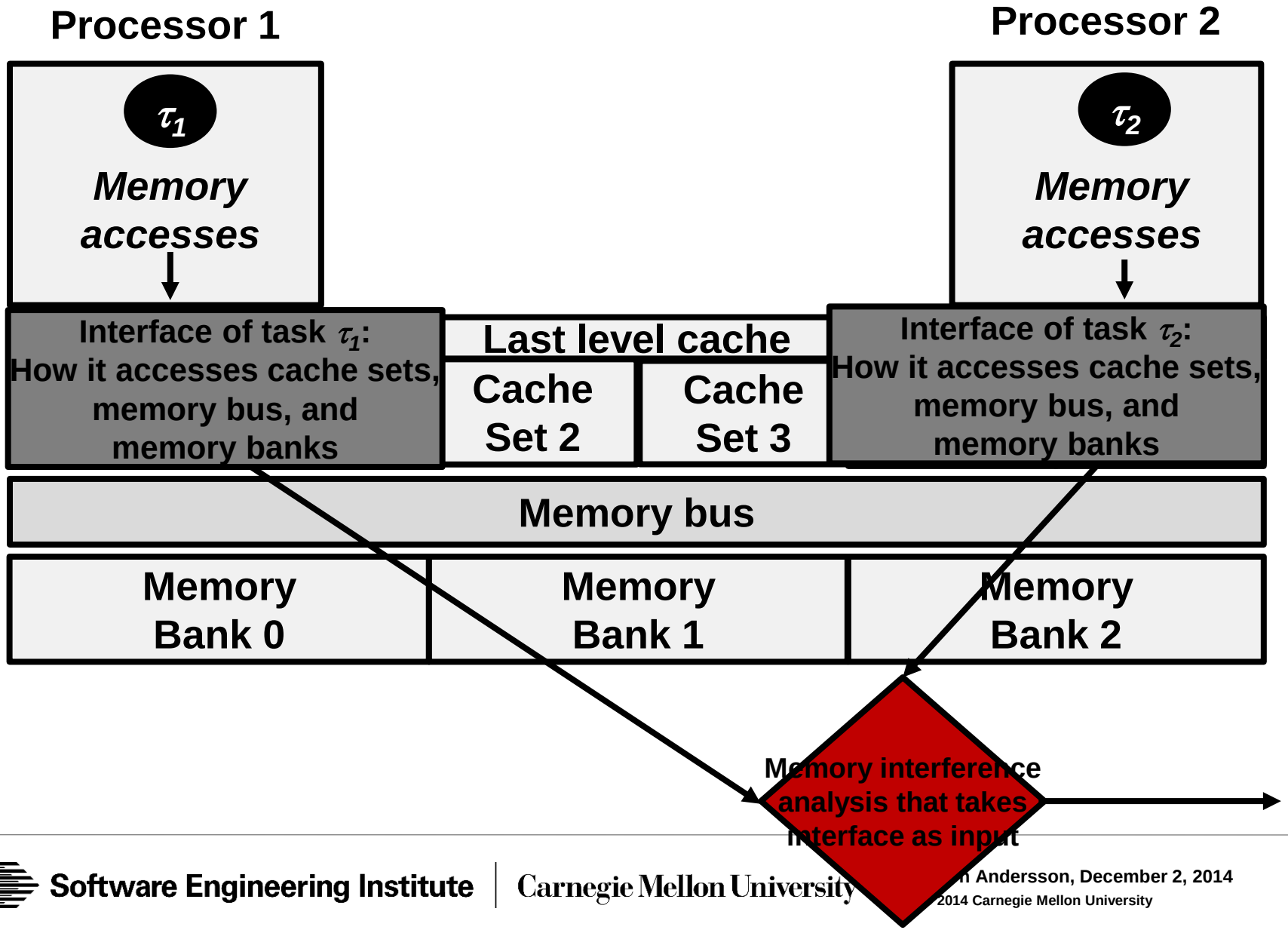


Problem: Design an interface with a finite cost.

Interface for memory accesses



Interface for memory accesses

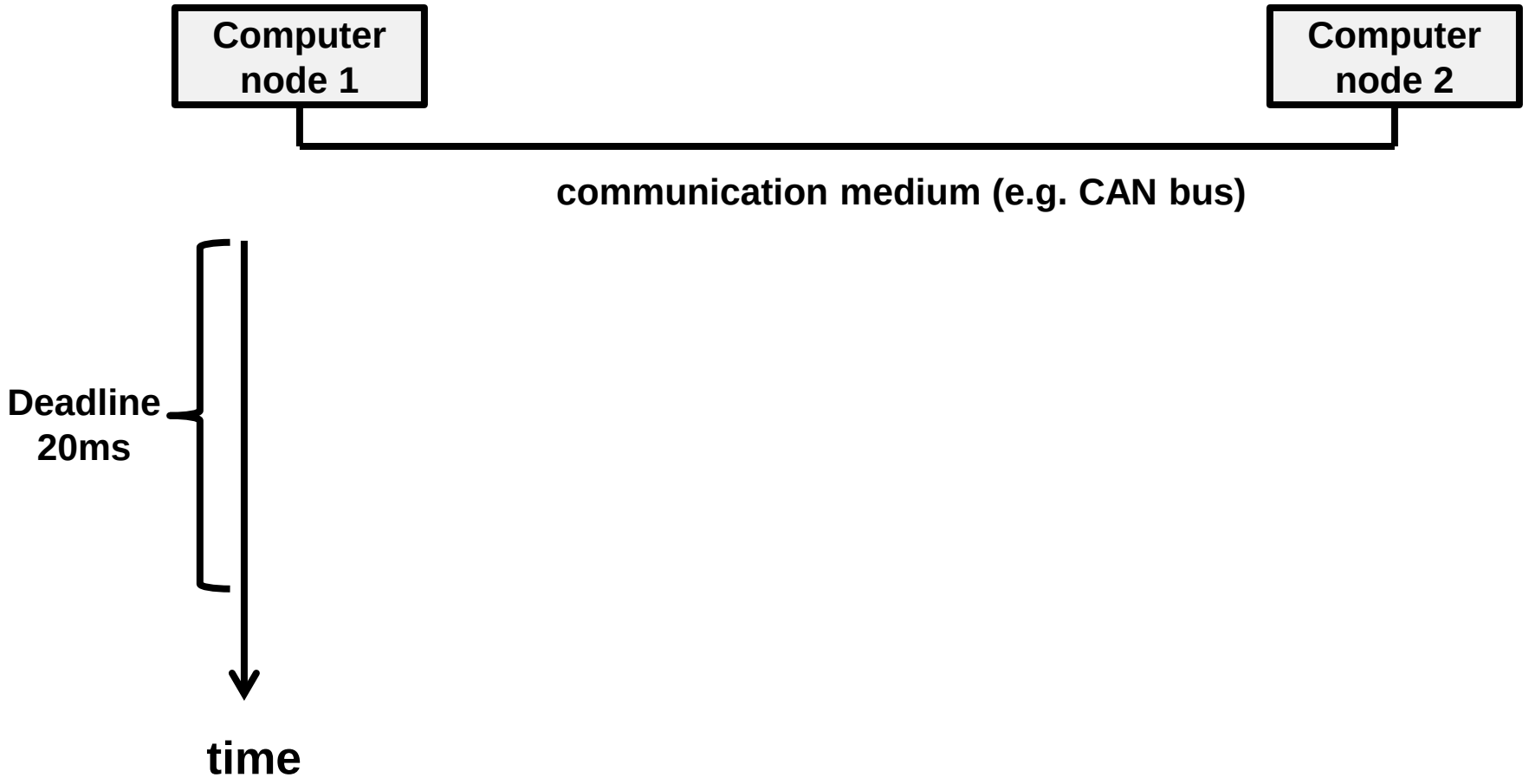


Interface for complex protocols

Interface for complex protocols

Computer node 1 requests the temperature of computer node 2. It does so by sending http get request. Timing requirement: Computer node 1 must receive temperature within 20ms

Interface for complex protocols



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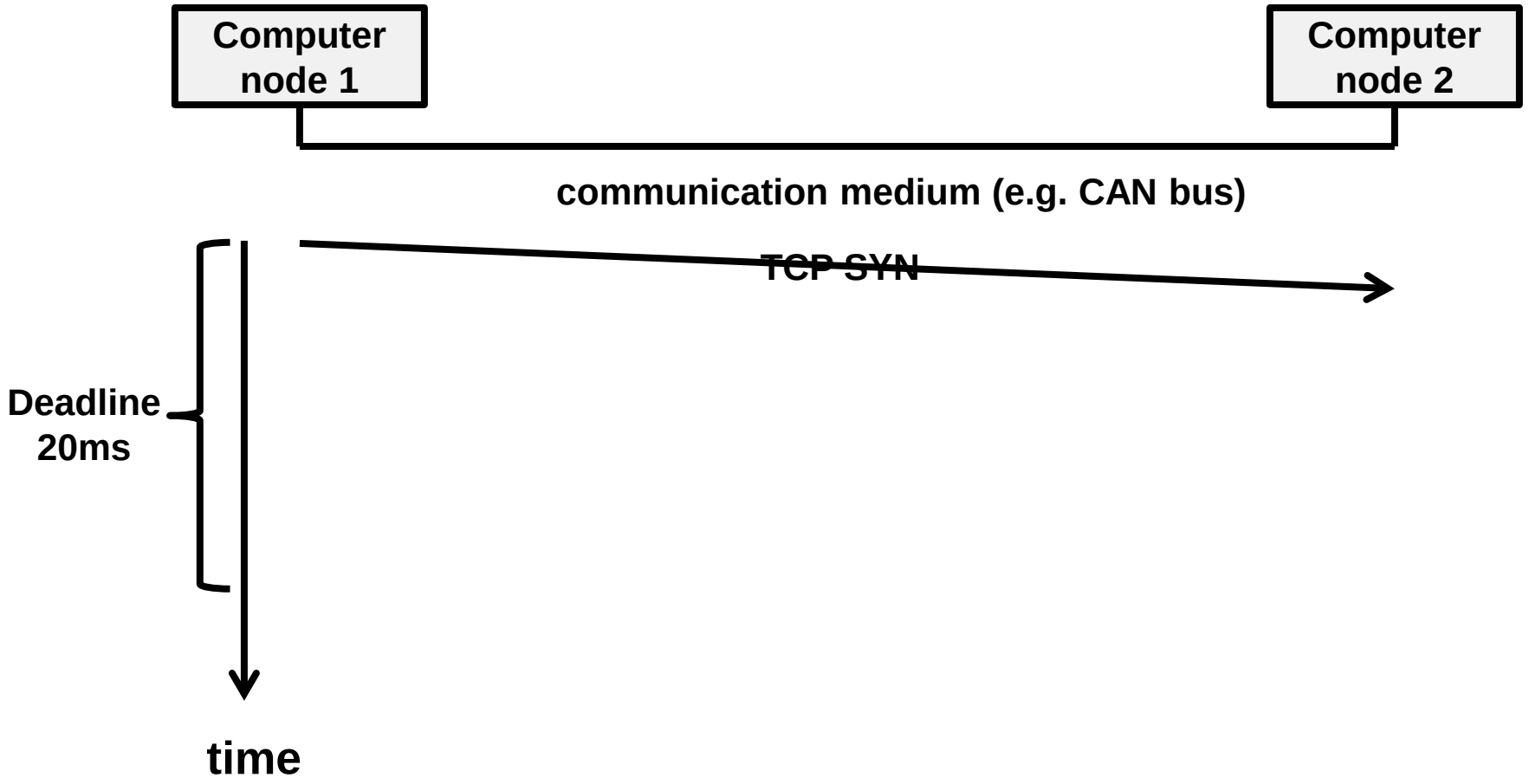

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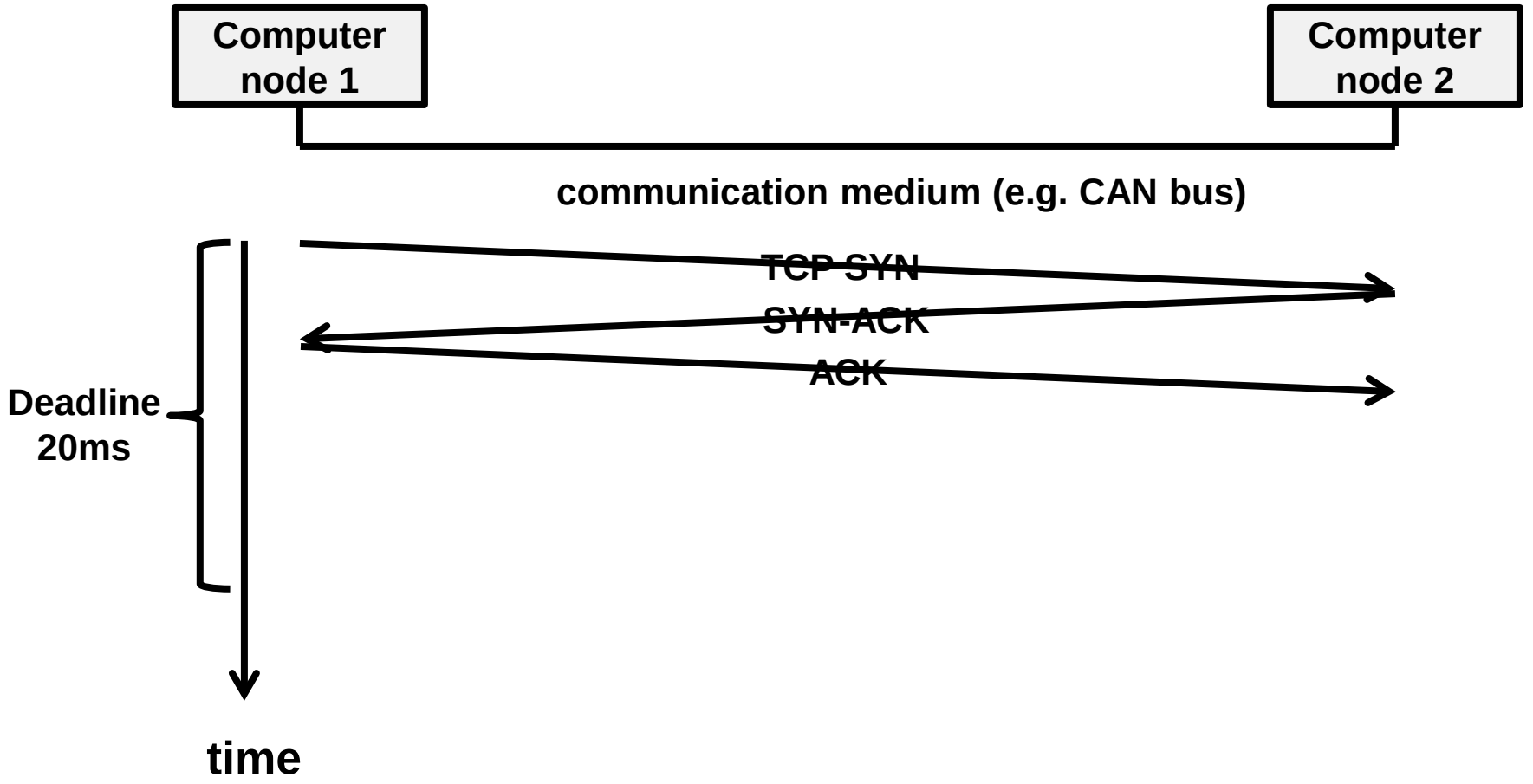

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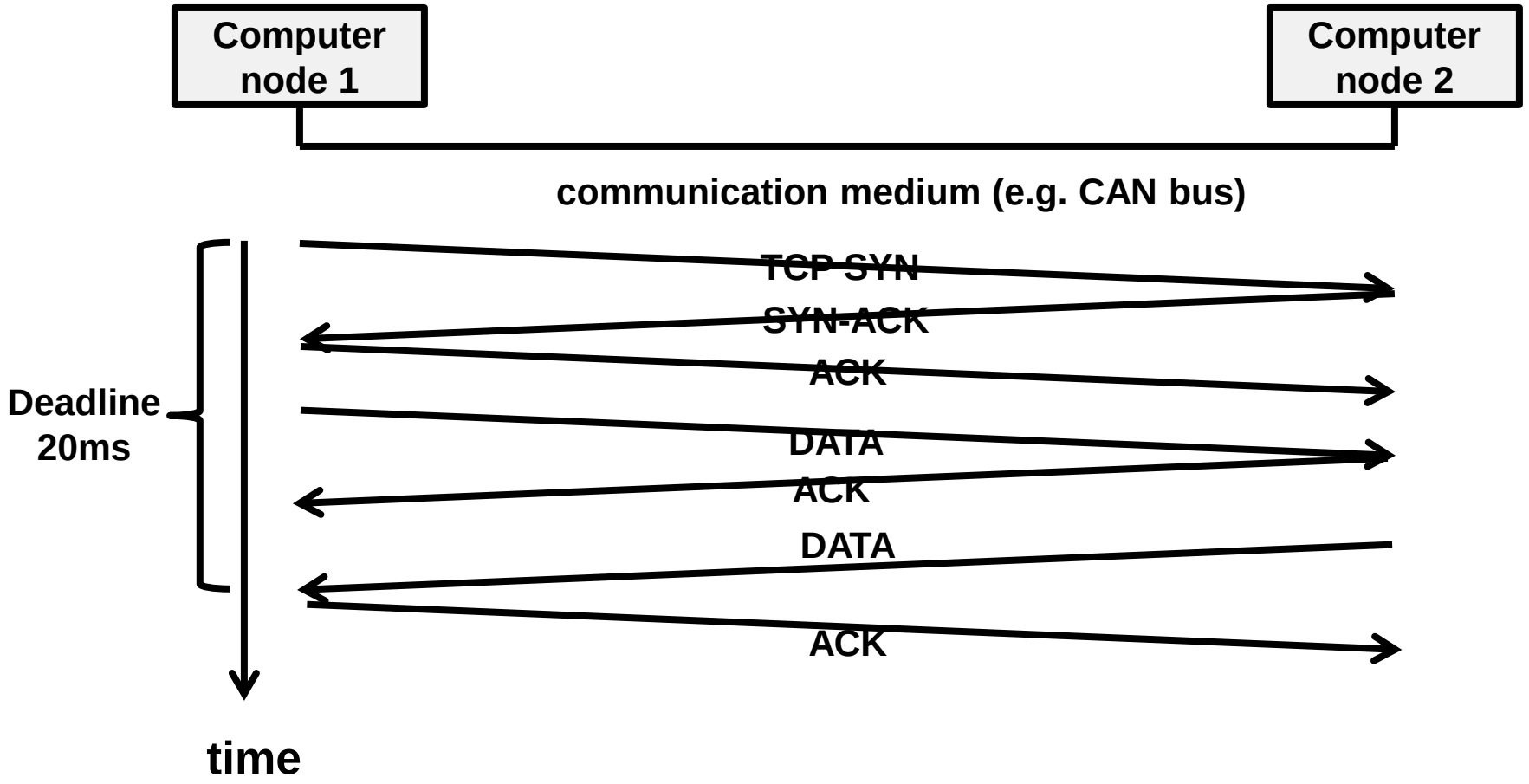

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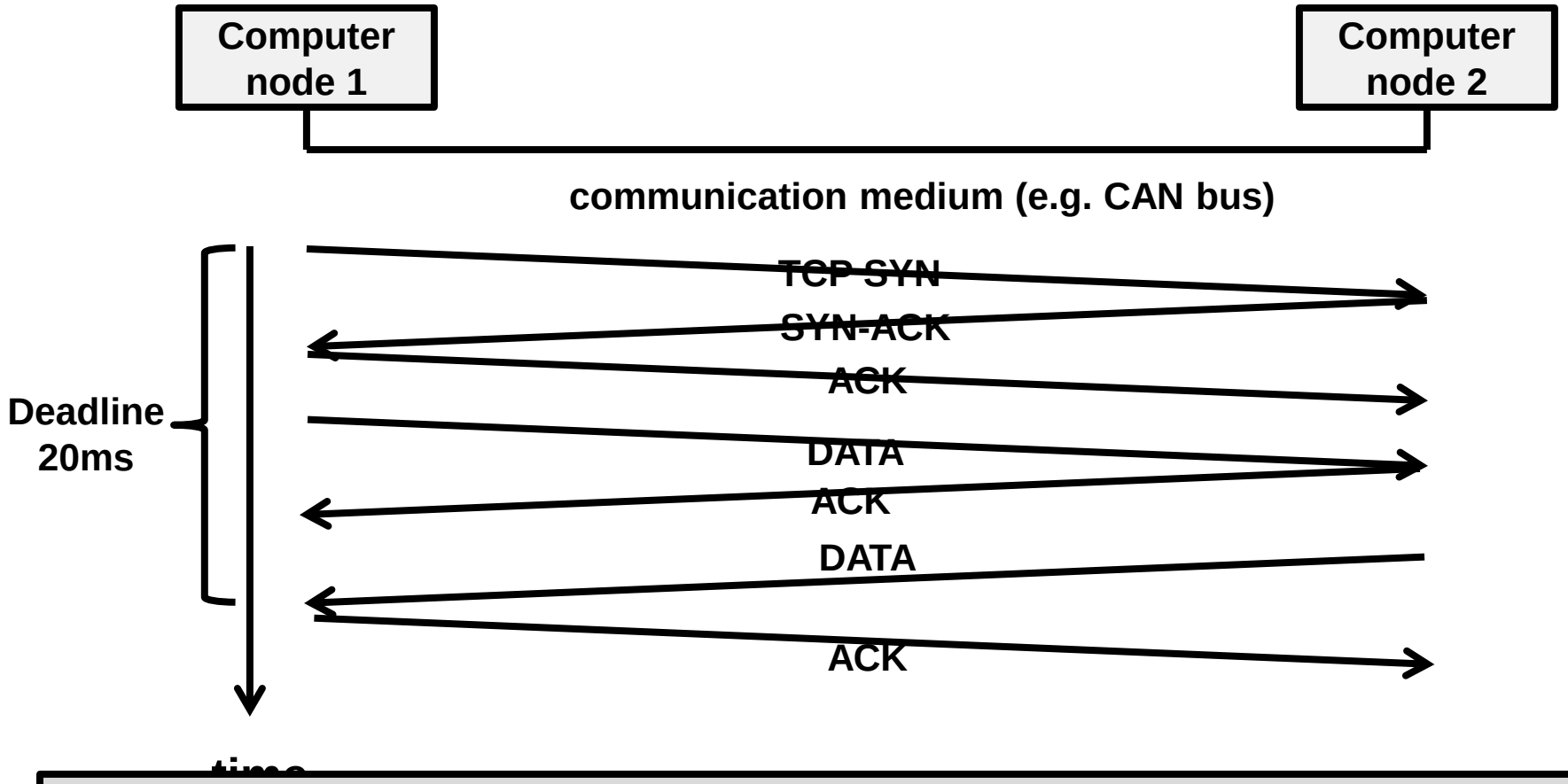
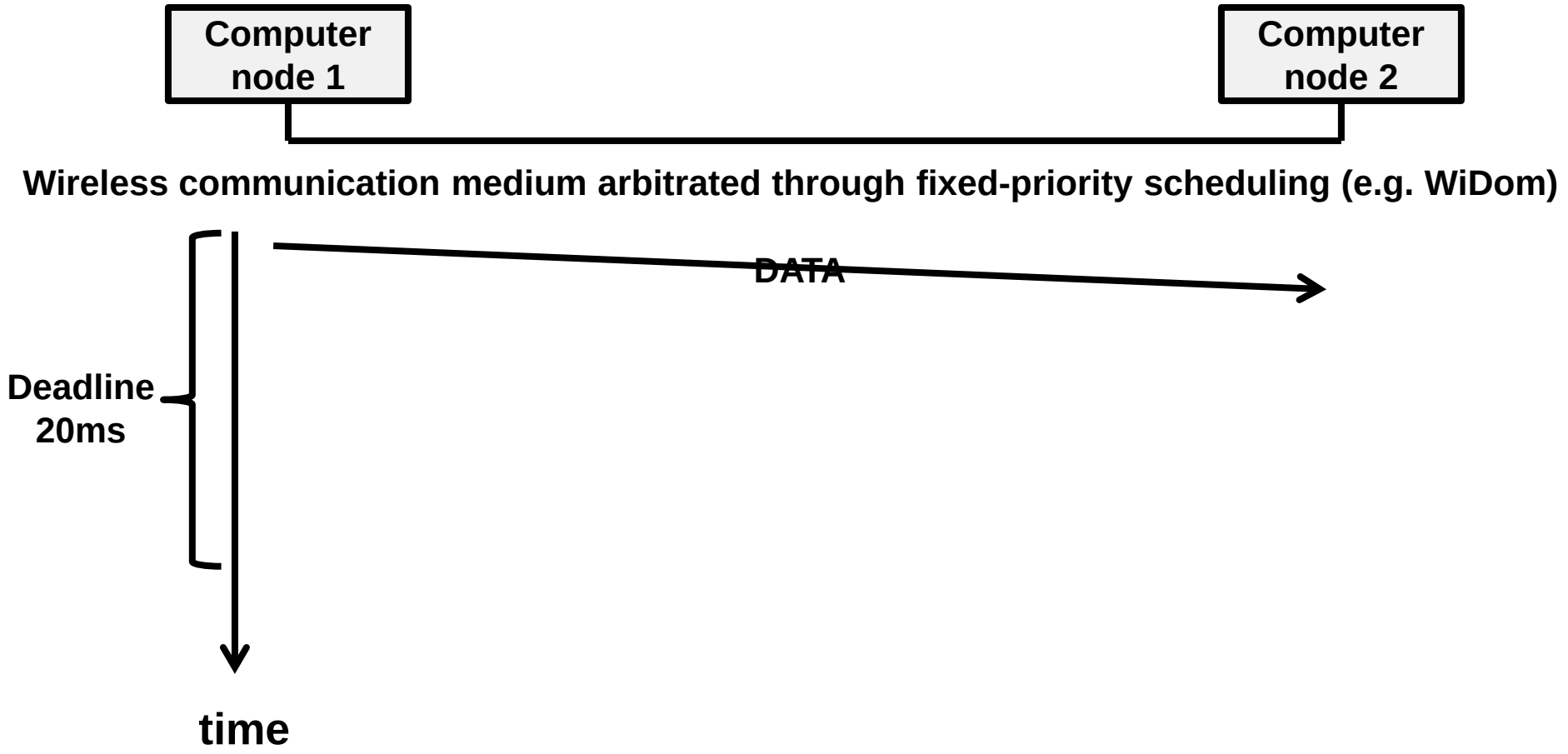


Problem: Create an interface that describes the resource consumption of the above messages (also deal with TCP flow control — more complex)

Interface for wireless traffic



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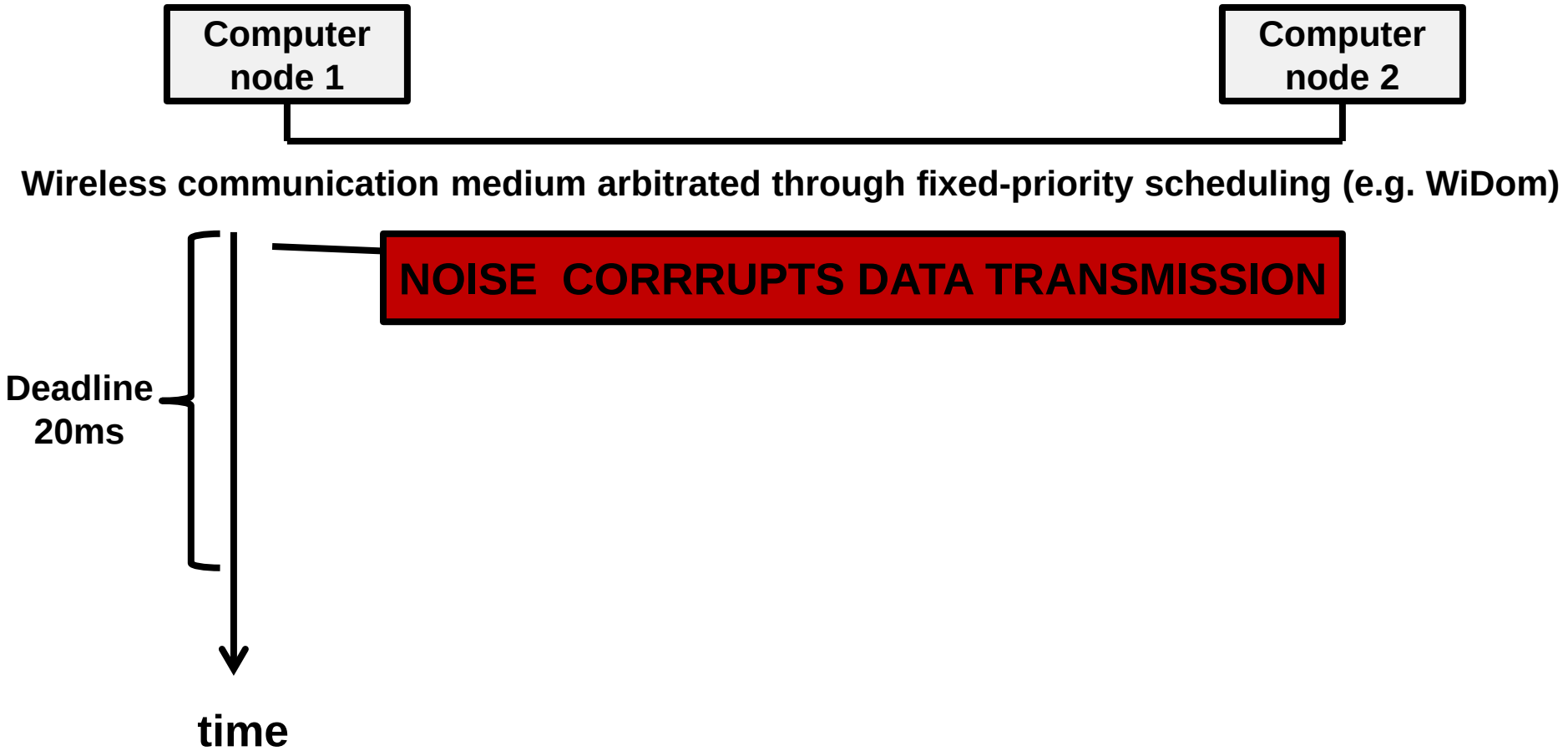

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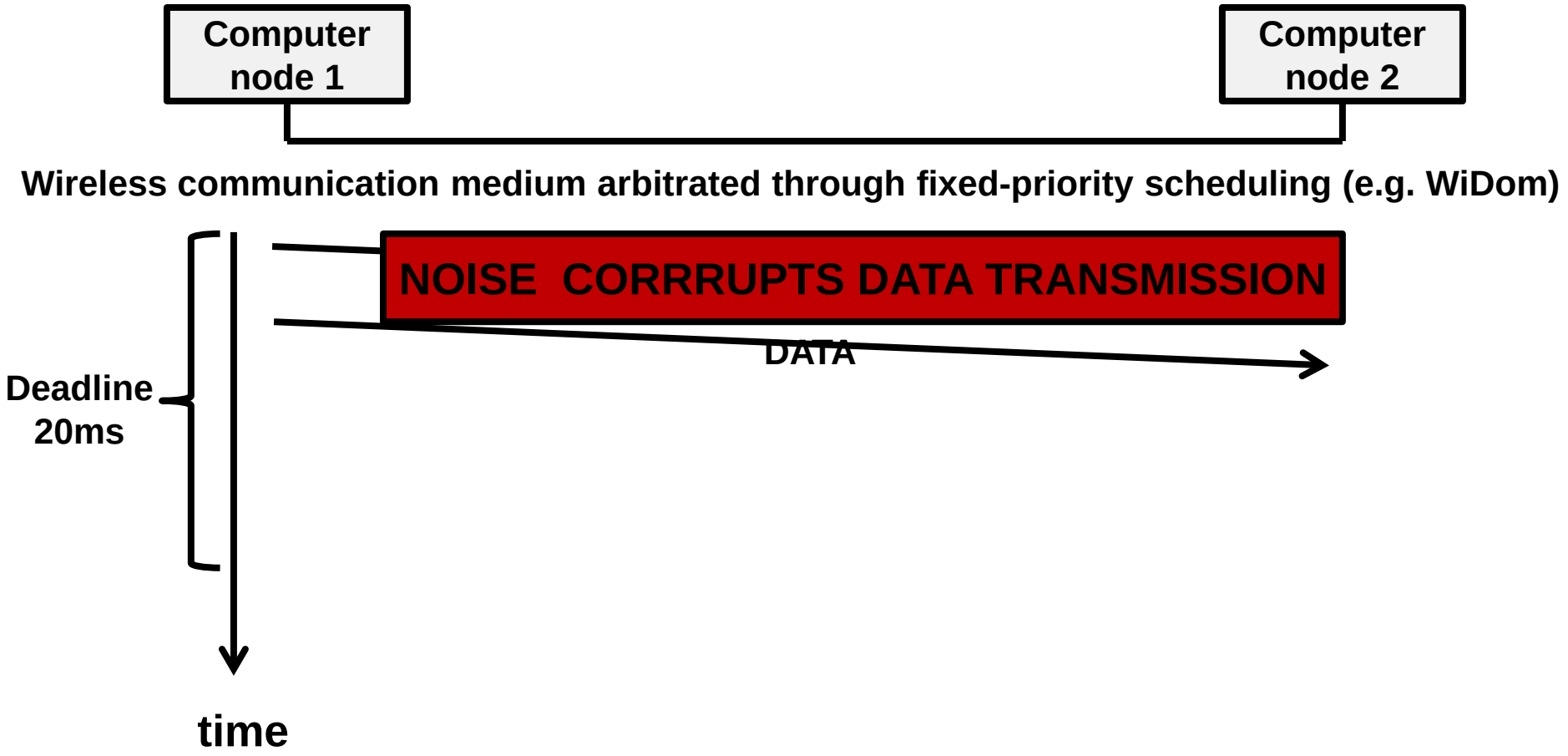

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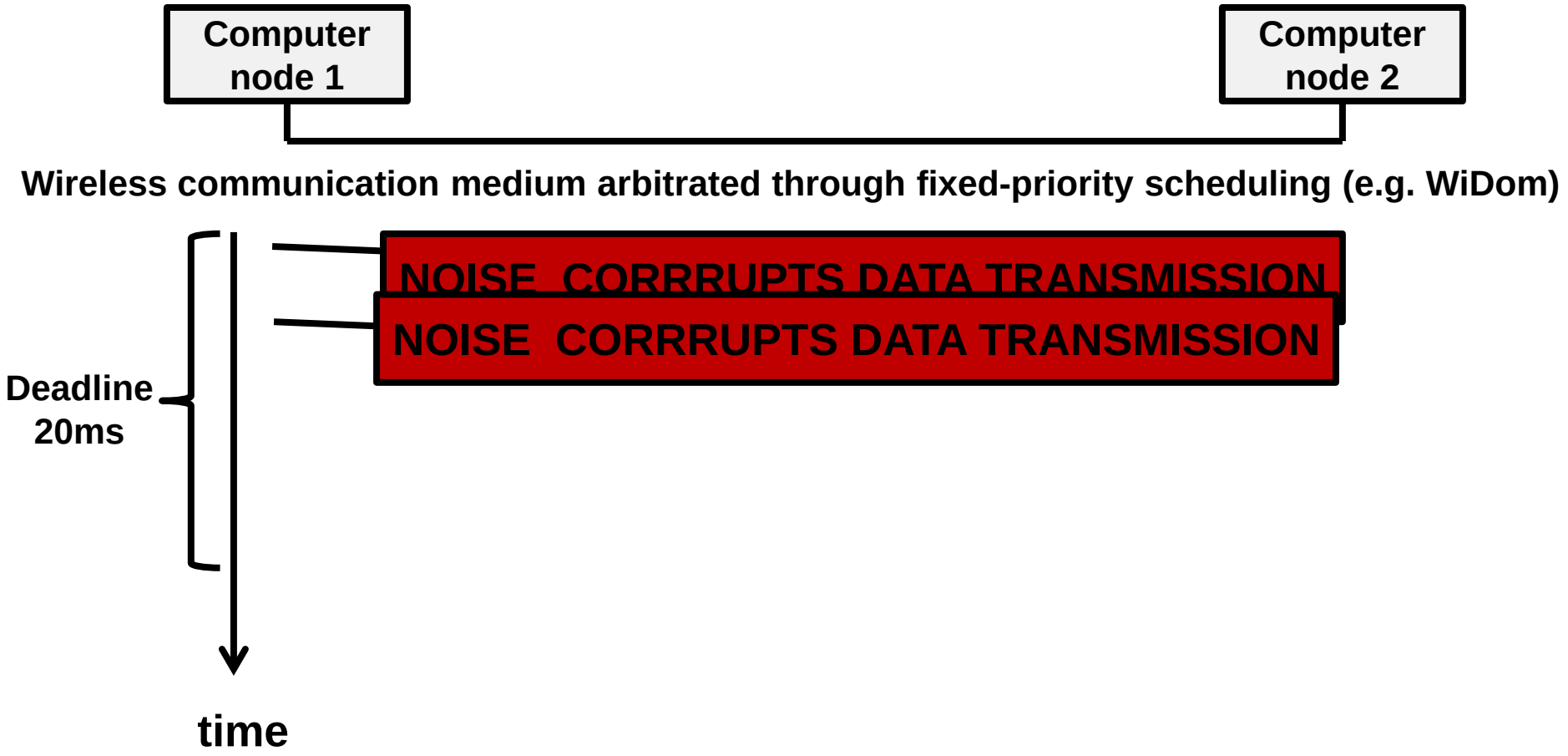

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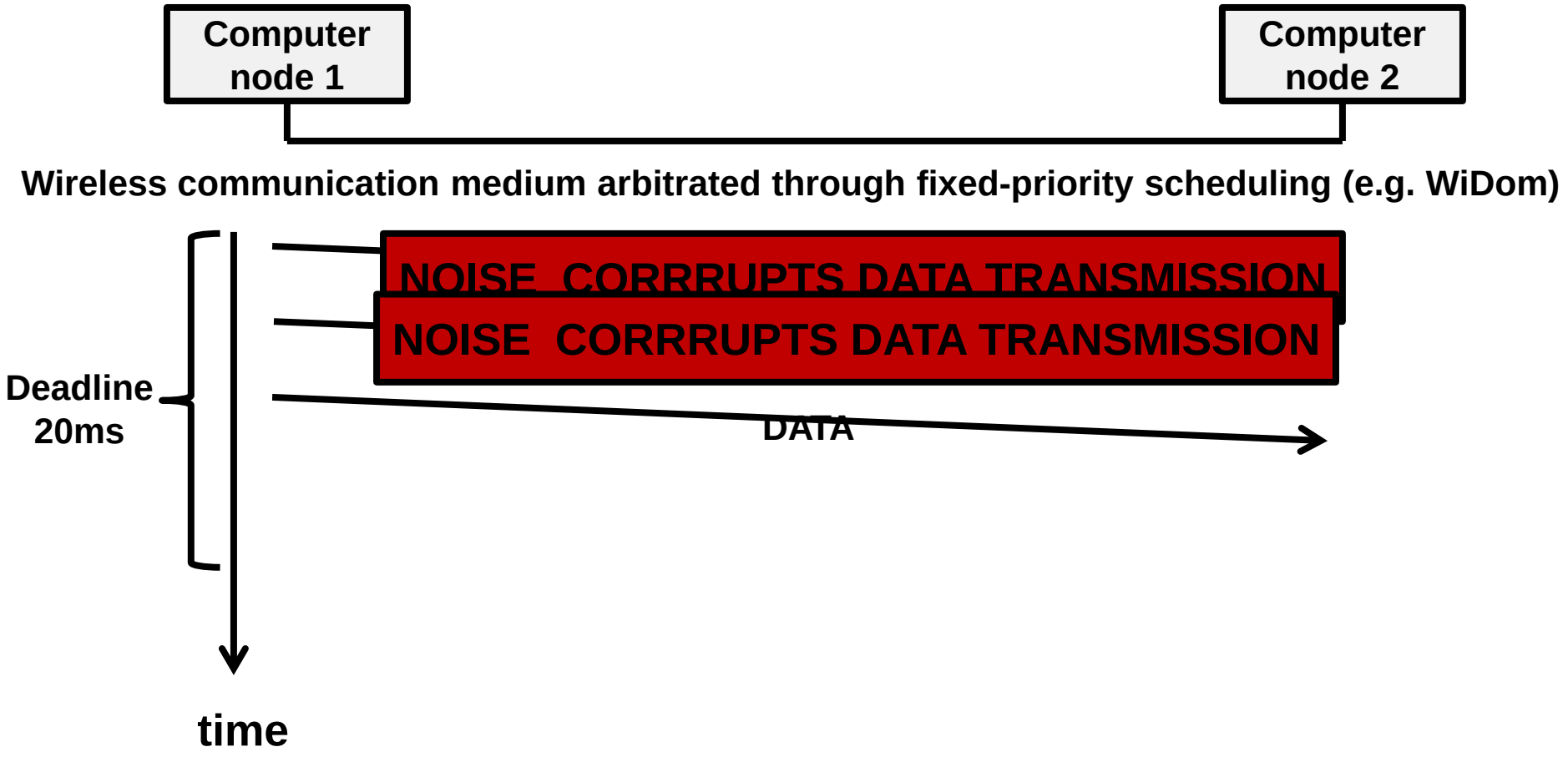

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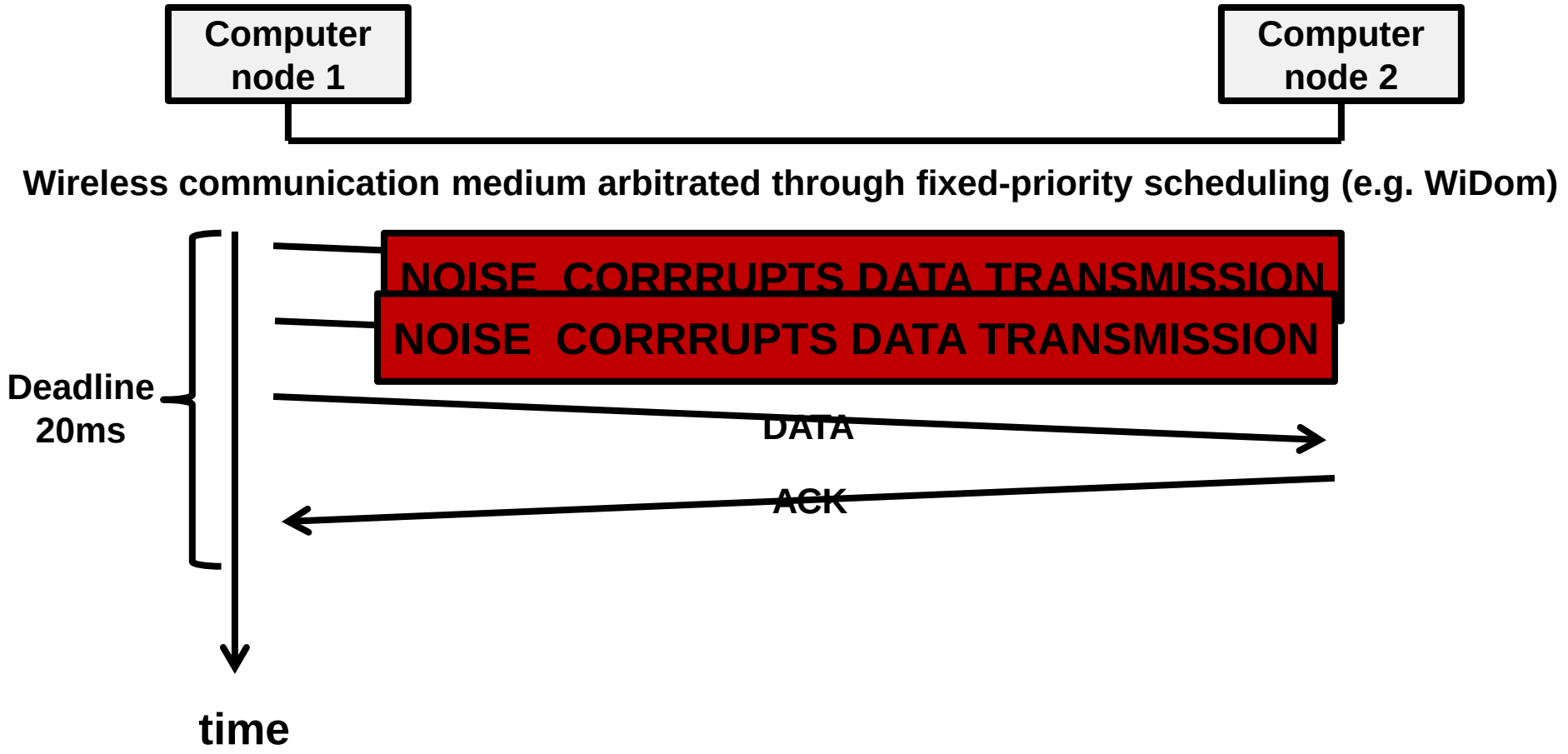

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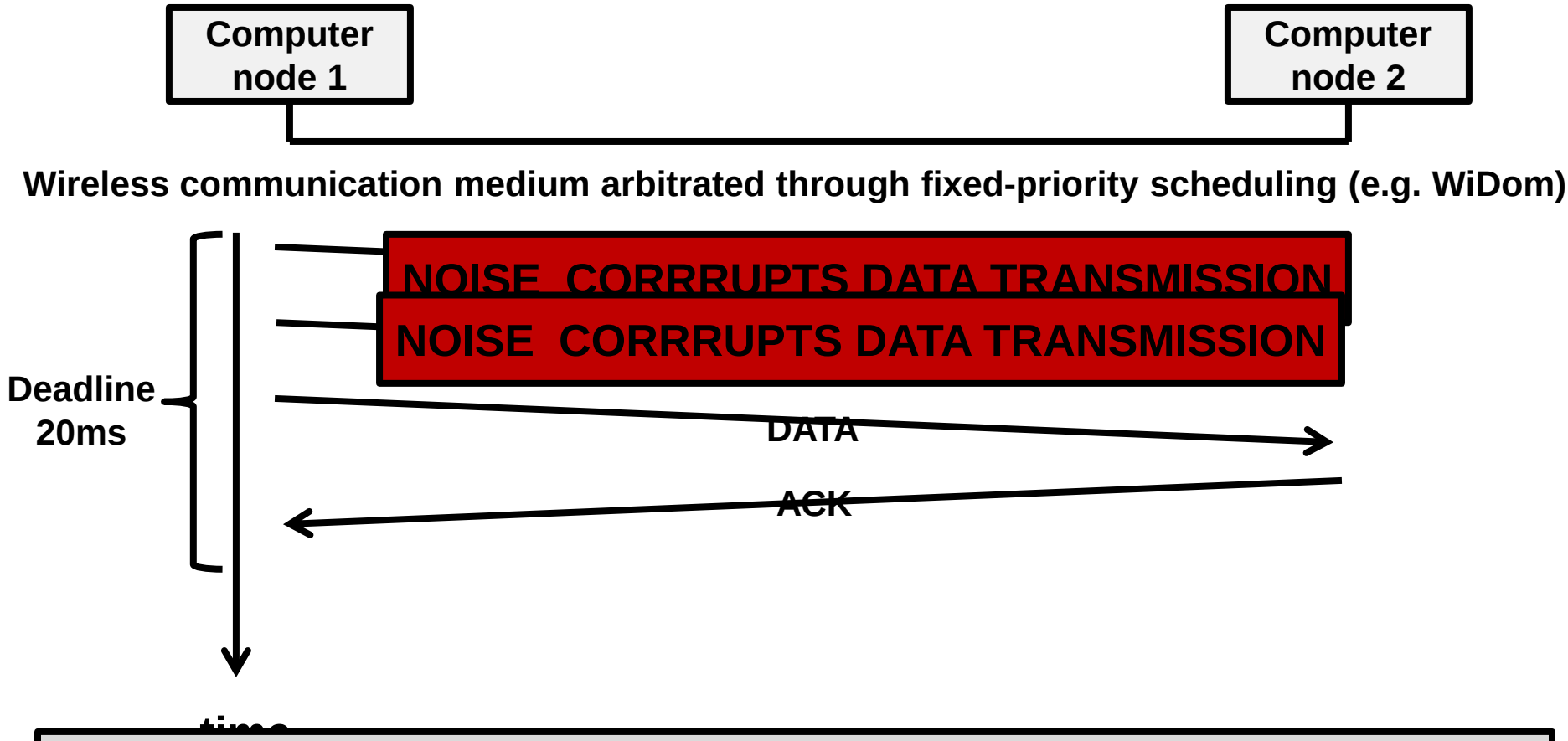
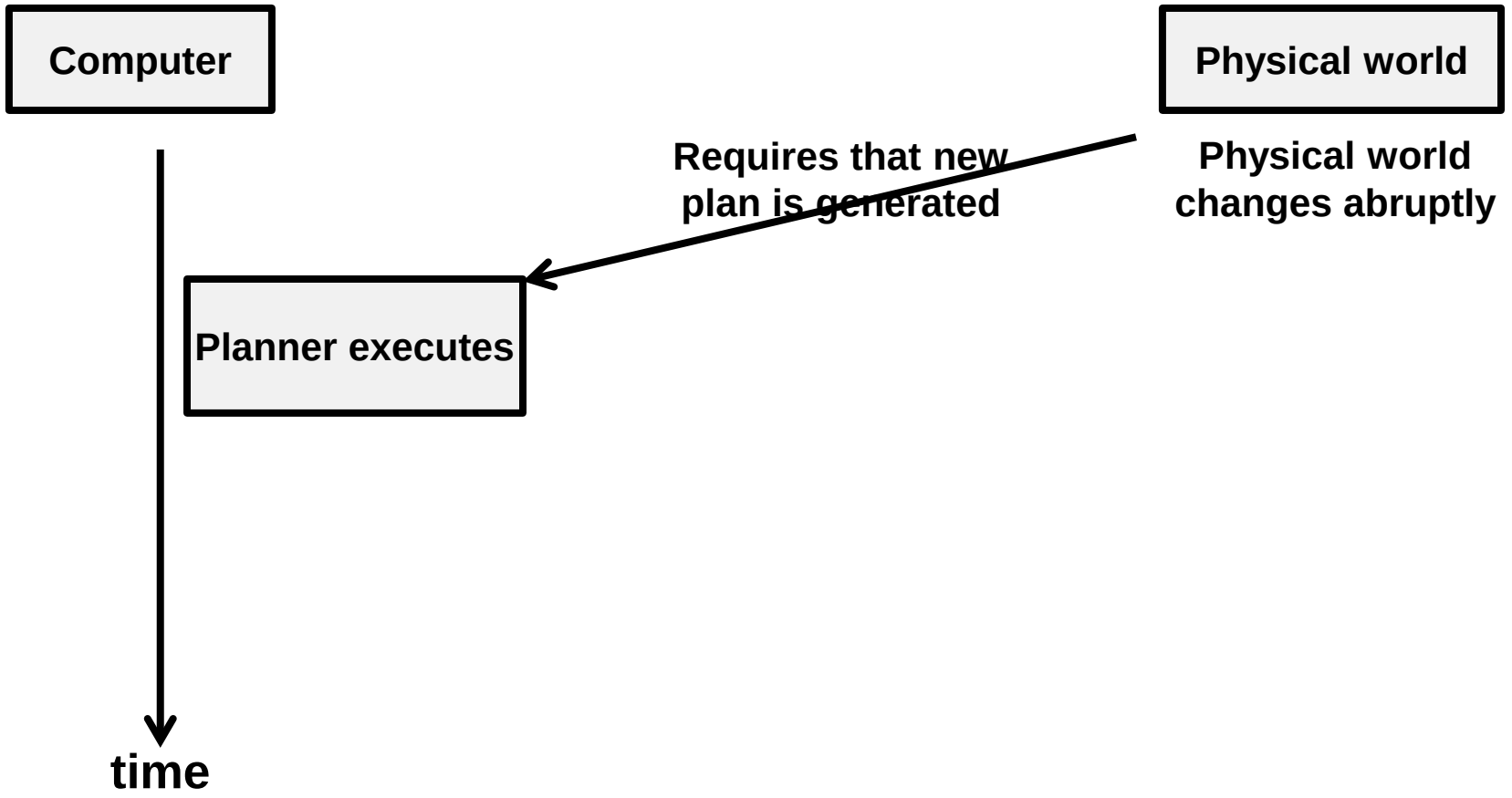


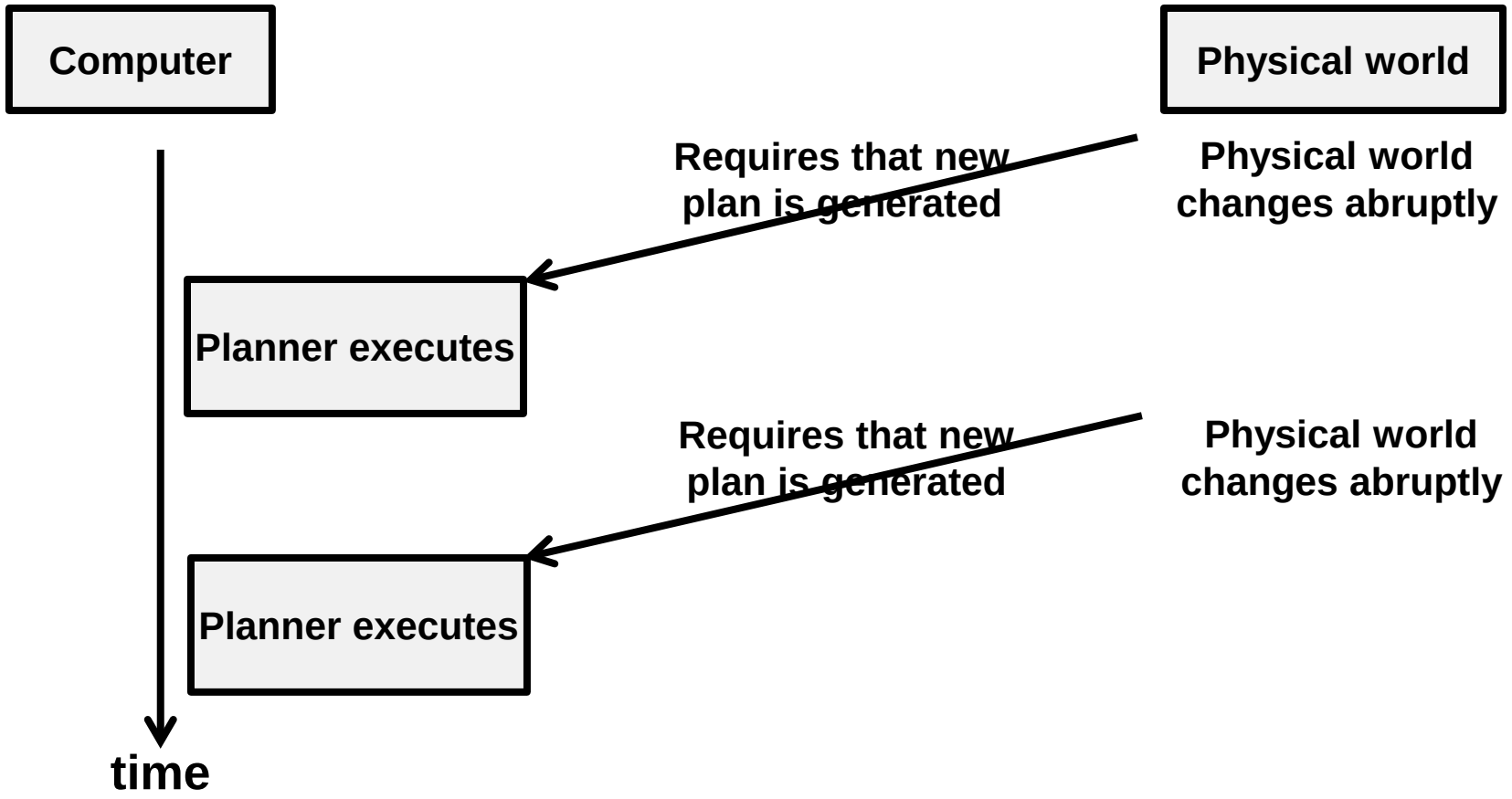
Problem: Create an interface that describes the resource consumption of the above messages as a function of channel imperfections (noise/distortion)

Interface for autonomous cars



Problem: Create an interface that describes the resource consumption of the planner software as a function of the "eventfulness" or "unexpectedness" of the environment.

Interface for autonomous cars



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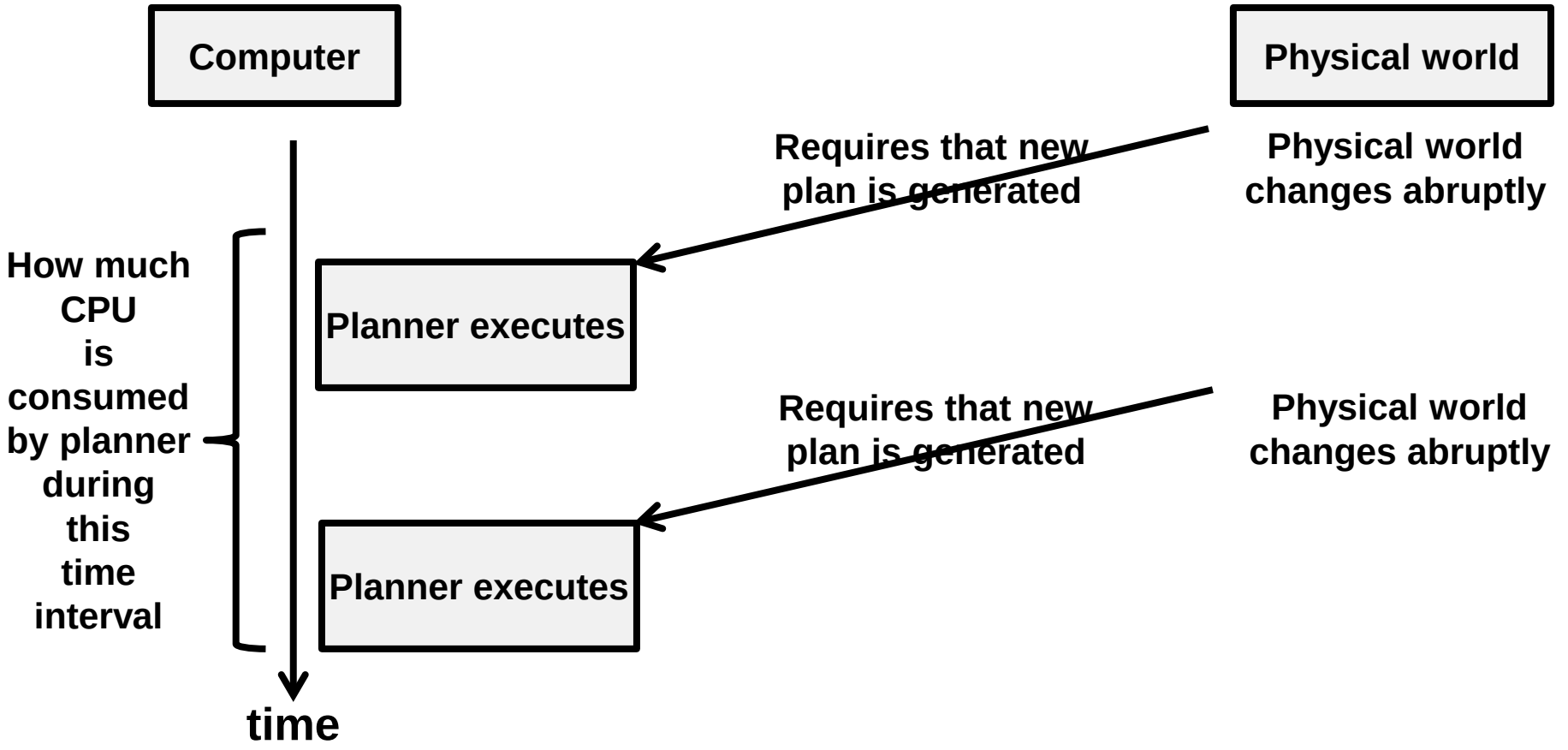

Problem: Create an interface that describes the resource consumption of the planner software as a function of the "eventfulness" or "unexpectedness" of the environment.

Summary of the state-of-the-art

Interface design problem	Status
Interface for constrained-deadline sporadic tasks on a single processor	Partial solution
Interface for memory accesses	Very crude solutions
Interface for complex protocols	No solutions
Interface for wireless traffic	No solutions
Interface for autonomous cars	No solutions

Thanks!

Contact Information

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