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DM22-0108

DoD Systems Interact with Their Physical Environment



DoD Systems Include Software



DoD Systems Include Software That Interacts with the Physical Environment



DoD Systems Include Software That Has Real-Time Requirements



Satisfying Real-Time Requirements Is a Challenge for the DoD in General



Satisfying Real-Time Requirements Is Challenging for Upgrading the Blackhawk UH-60 Helicopter



Satisfying Real-Time Requirements Is Challenging for Upgrading the Blackhawk UH-60 Helicopter

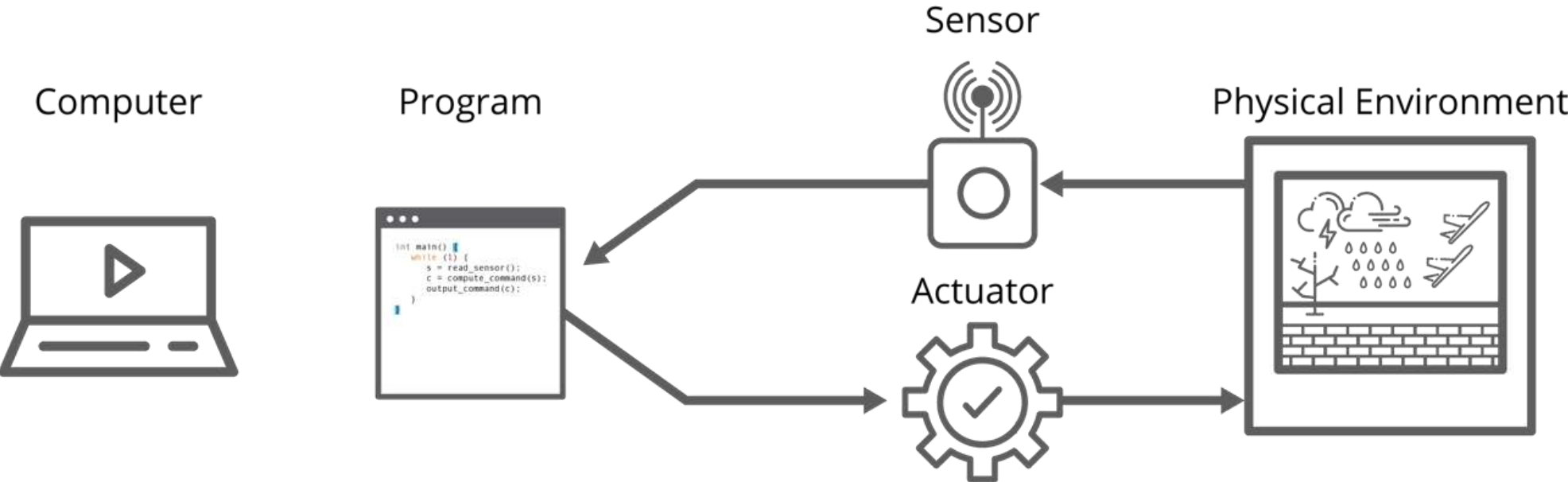


“The trick there, when you’re processing flight critical information, it has to be a deterministic environment, meaning we know exactly where a piece of data is going to be exactly when we need to — no room for error,” Langhout says. “On a multi-core processor there’s a lot of sharing going on across the cores, so right now we’re not able to do that.”

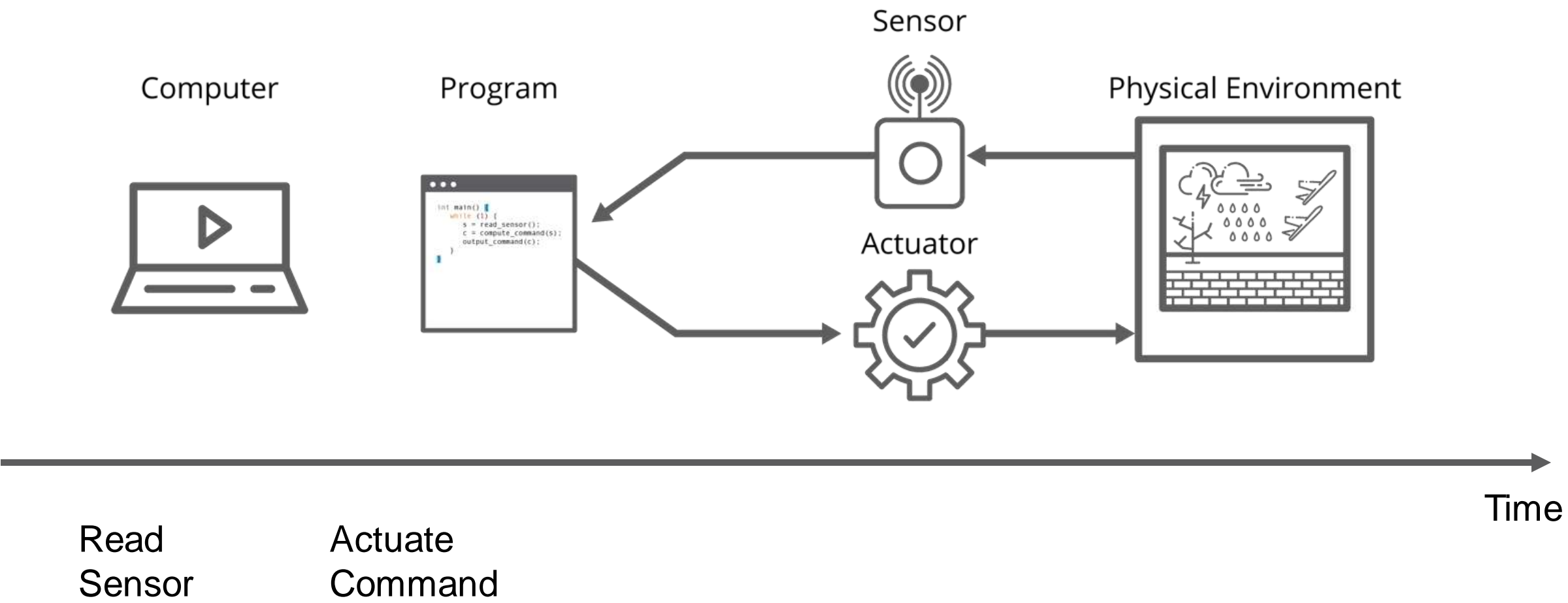
- Jeff Langhout, Acting Director, U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC)

Source: “Army still working on multi-core processor for UH-60V,” May 2017, Available at <https://www.flightglobal.com/news/articles/army-still-working-on-multi-core-processor-for-uh-6-436895/>.

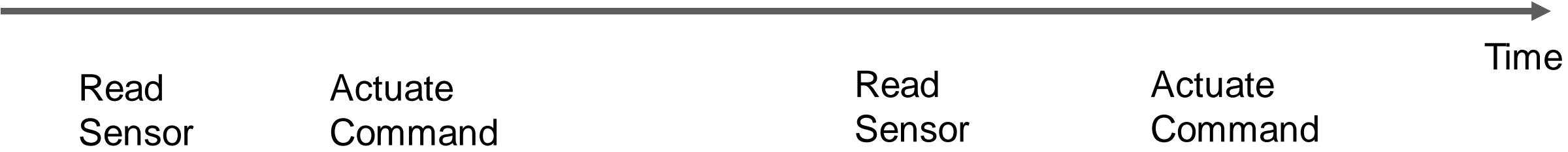
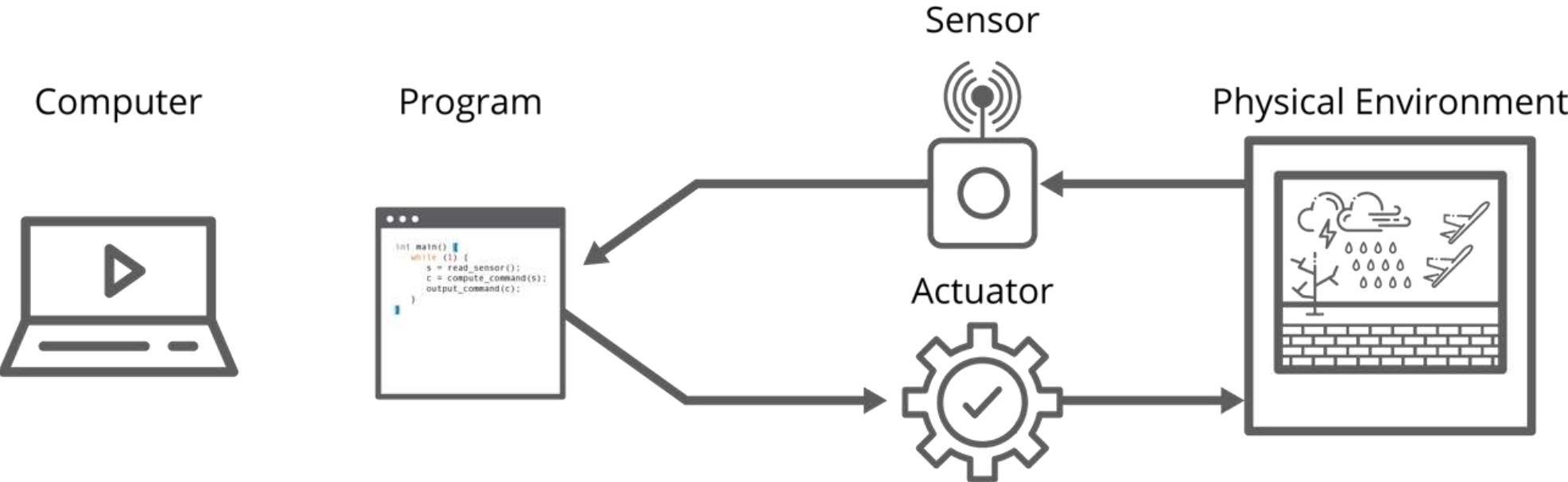
Commonality of DoD Systems



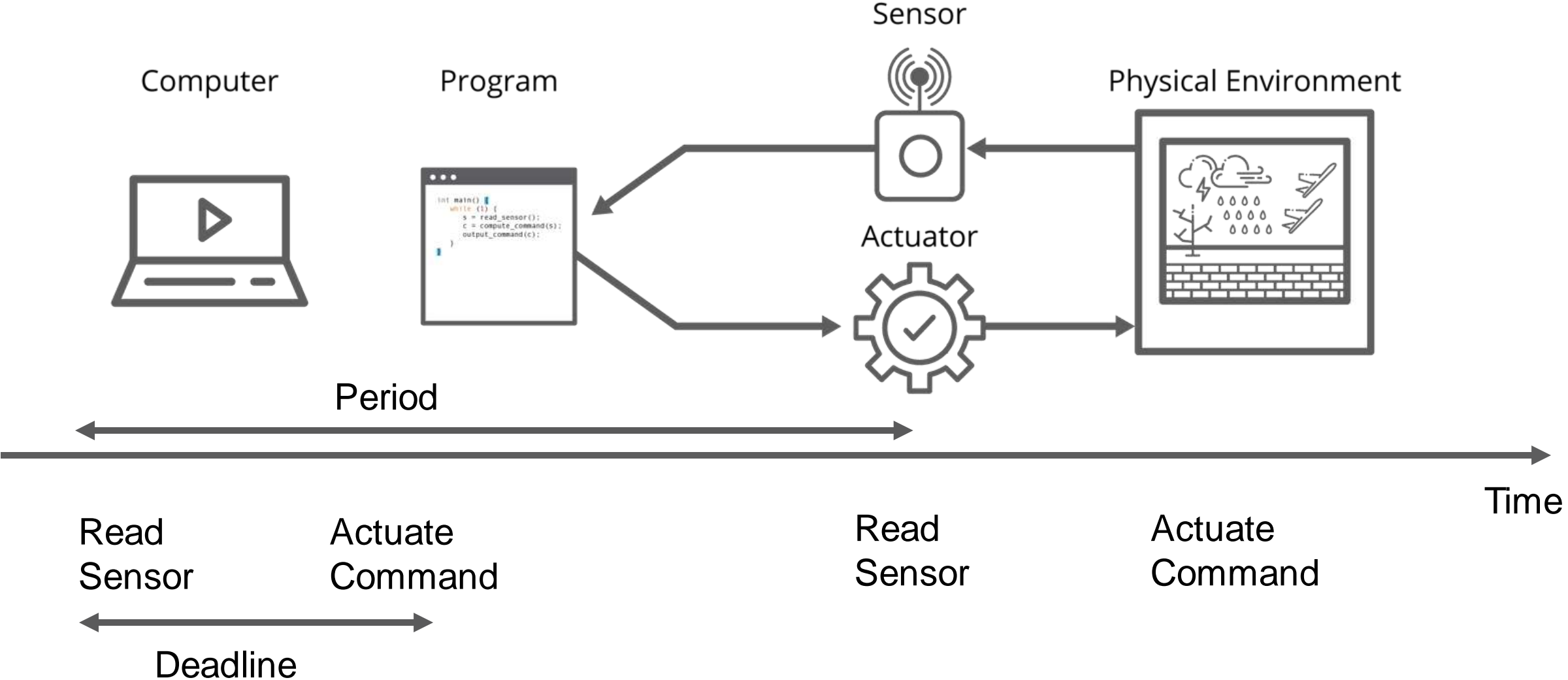
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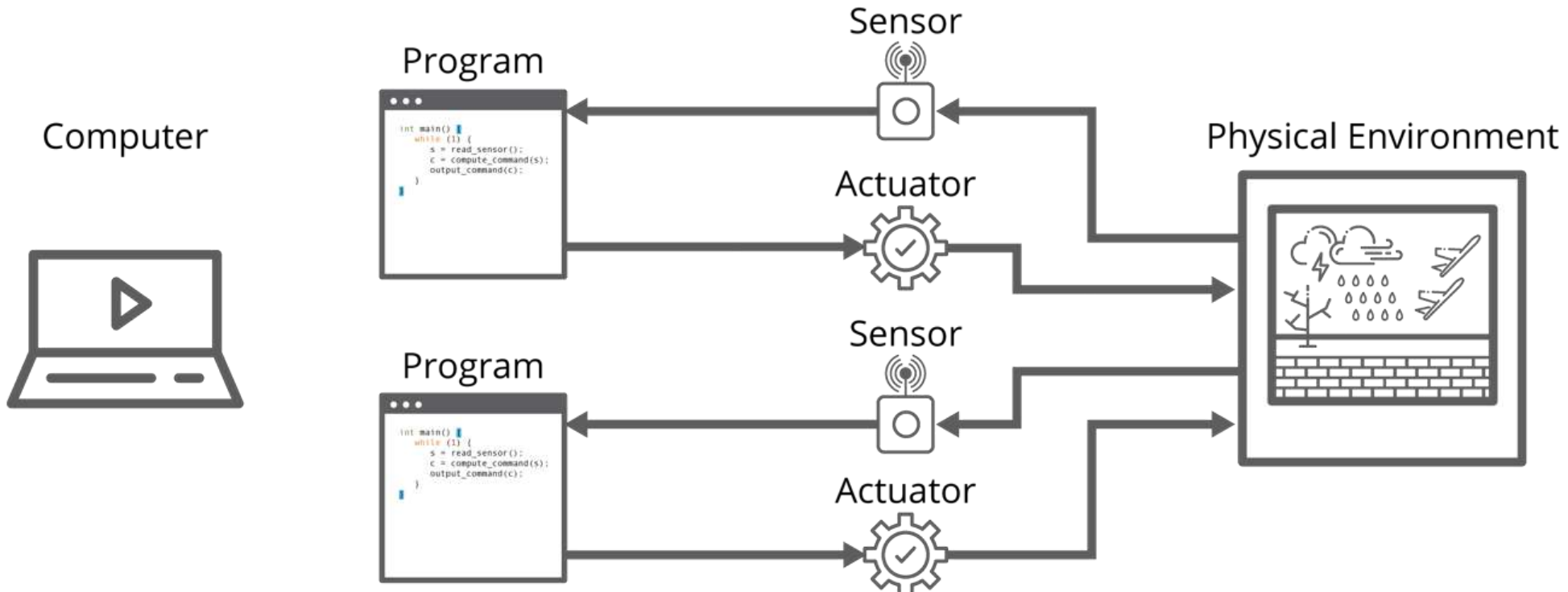
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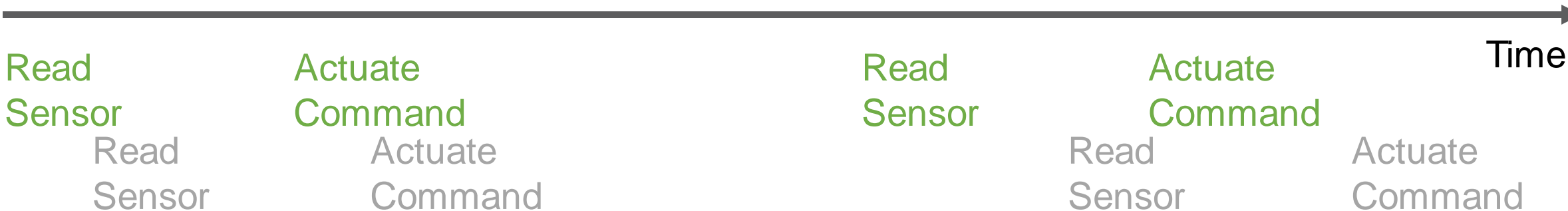
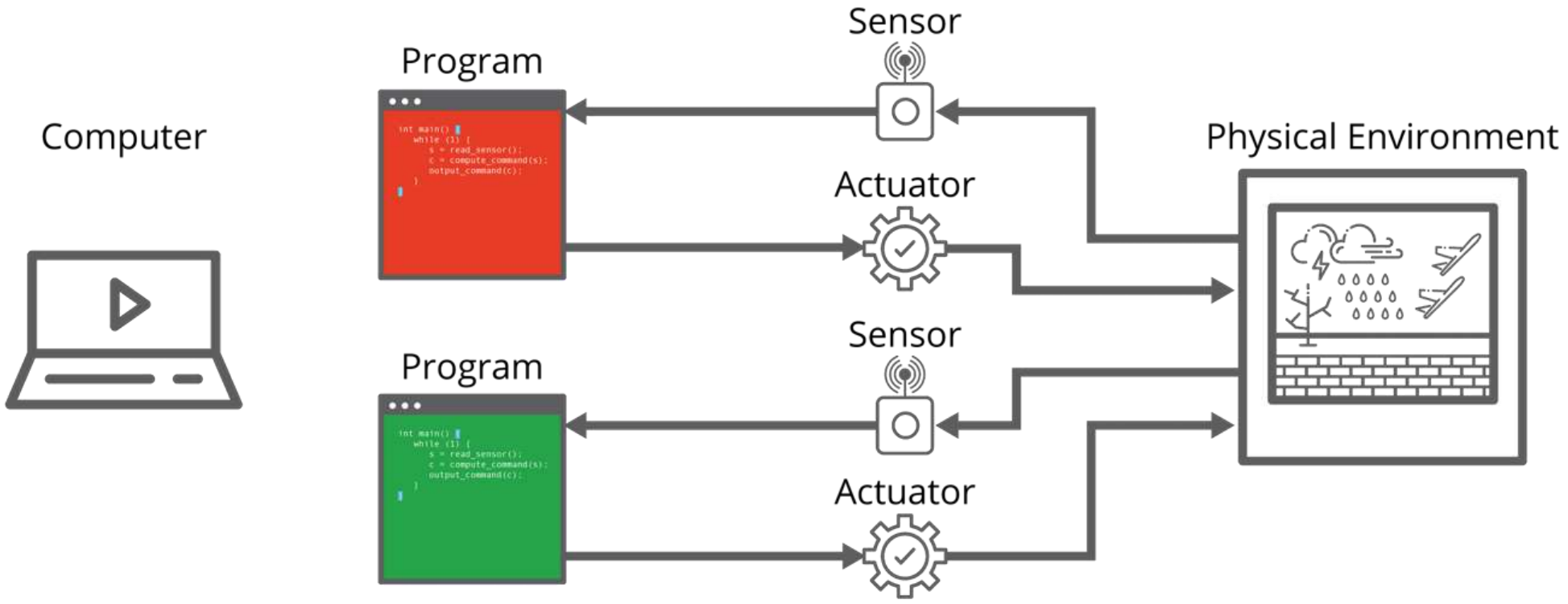
Commonality of DoD Systems



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Commonality of DoD Systems



Why is Satisfying Real-Time Requirements Challenging?

What Causes Delay of Software?

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Time

What Causes Delay of Software?



What Causes Delay of Software?

Thread executes
one path

Time when one thread
in the software system arrives

Deadline

Time



What Causes Delay of Software?



What Causes Delay of Software?

Preemption:
Another thread uses
the processor.

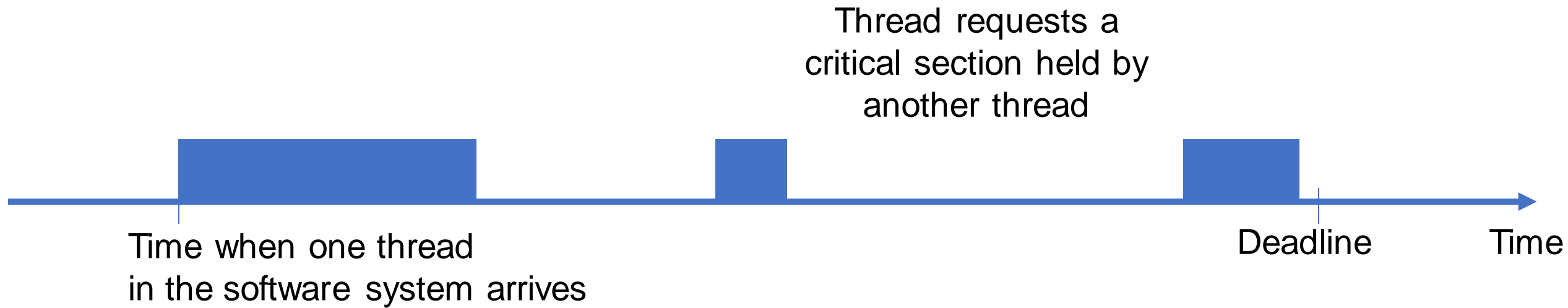
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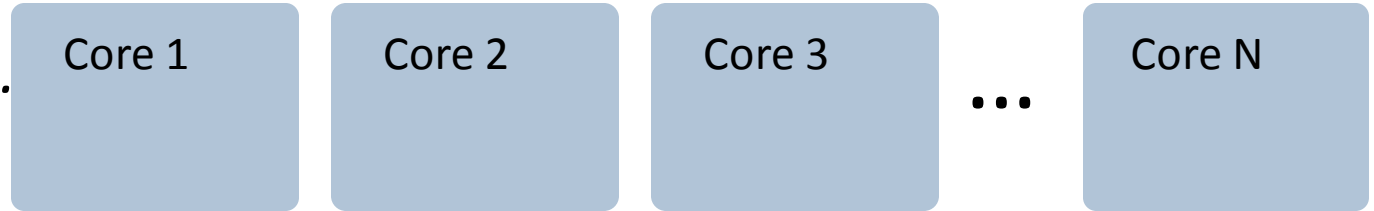
What Causes Delay of Software?



Real-Time Requirements of Software Executing on a Multicore Processor

Hardware Trends

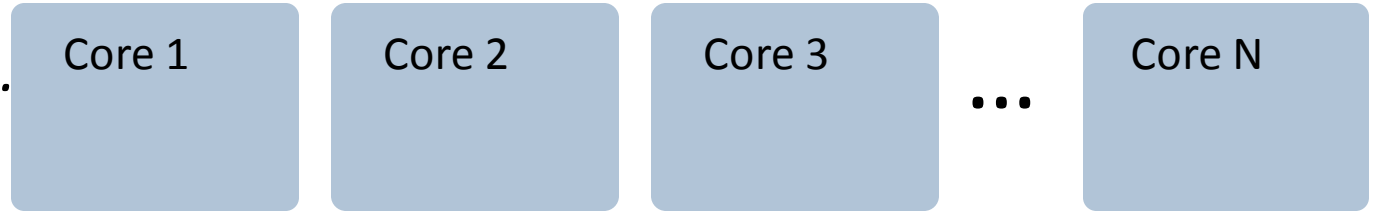
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Real-Time Requirements of Software Executing on a Multicore Processor

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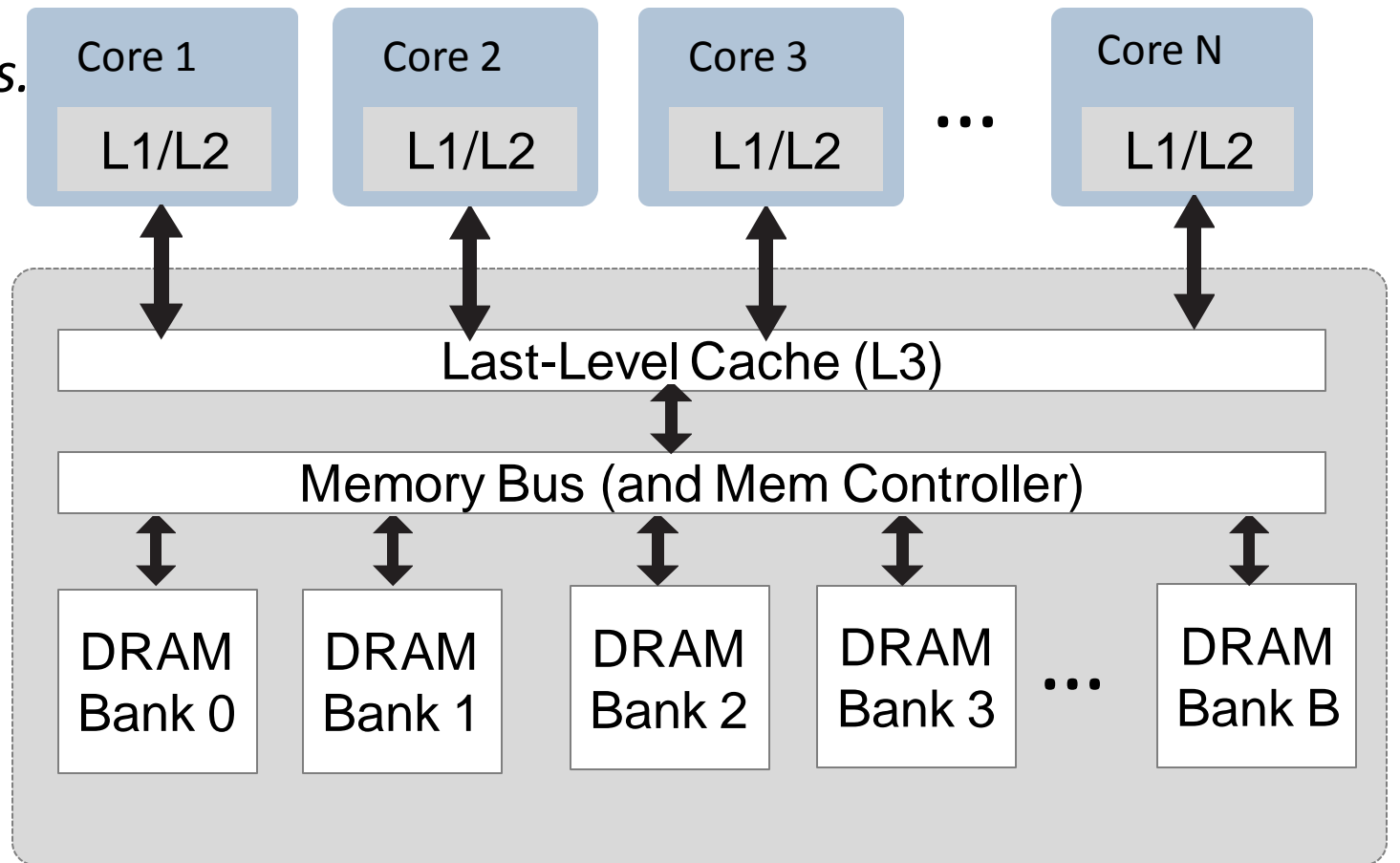
- *All computers are multicores.*
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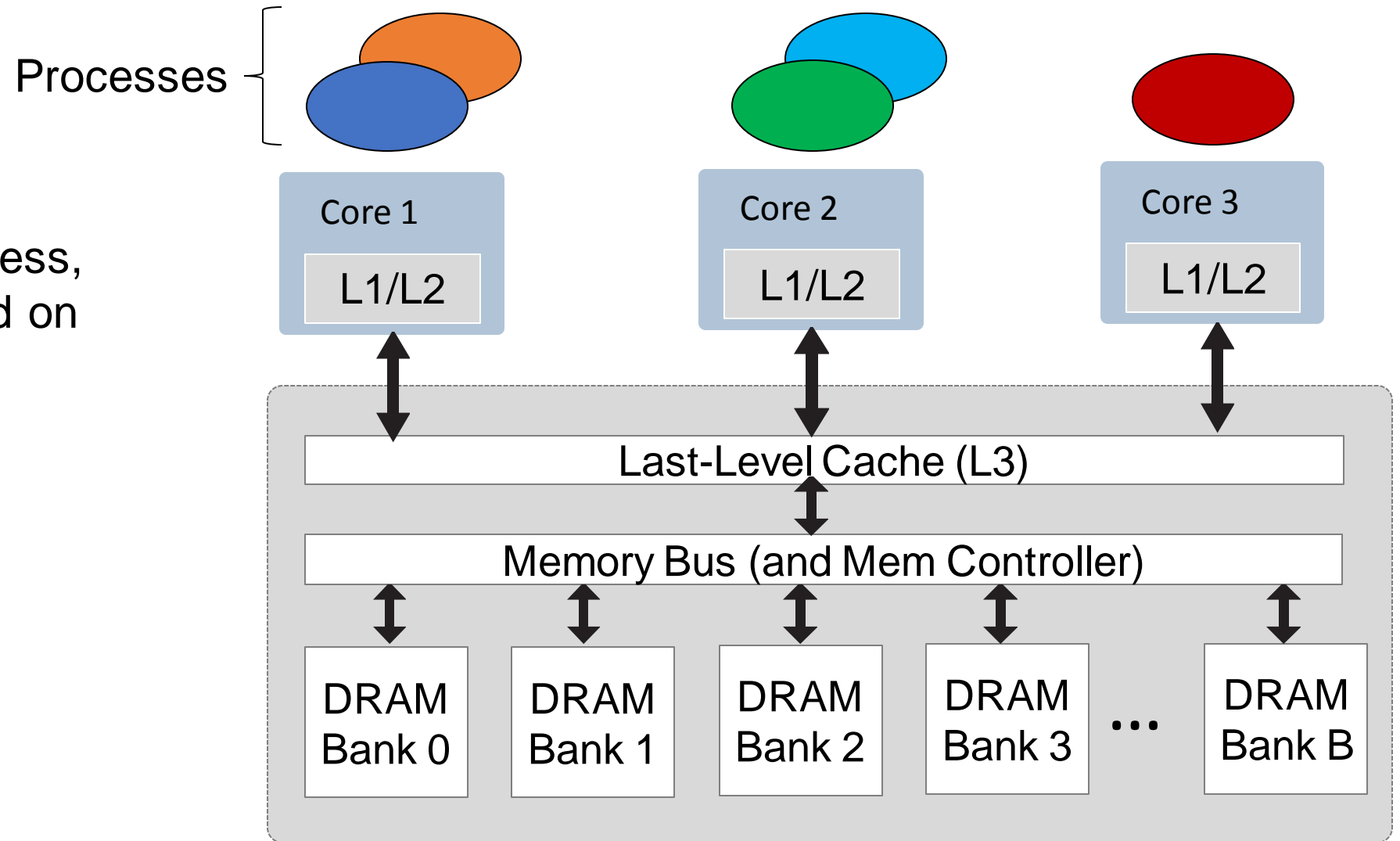
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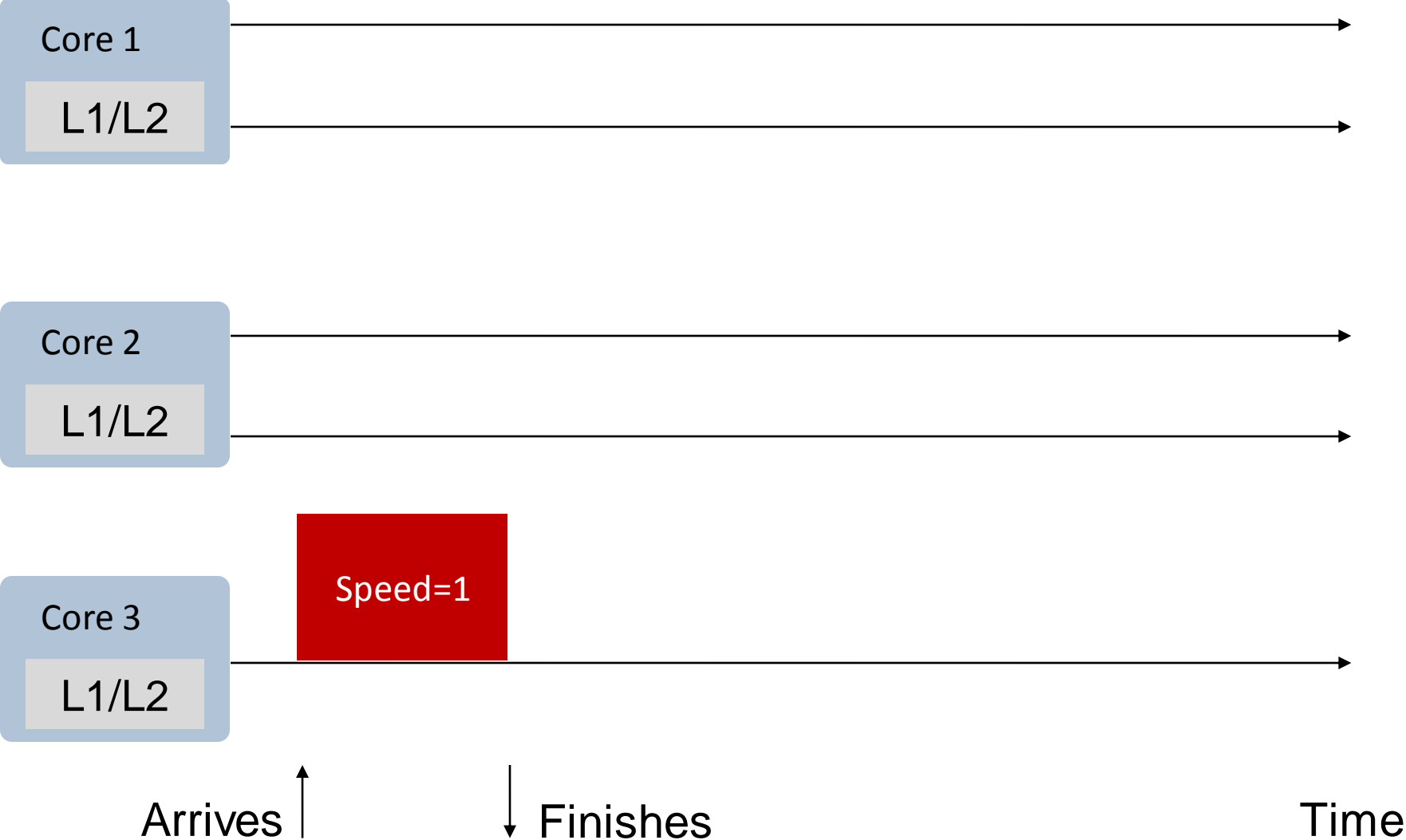
- *All computers are multicores.*
- *Most chip makers do not offer single core.*
- *Most multicores have shared memory.*



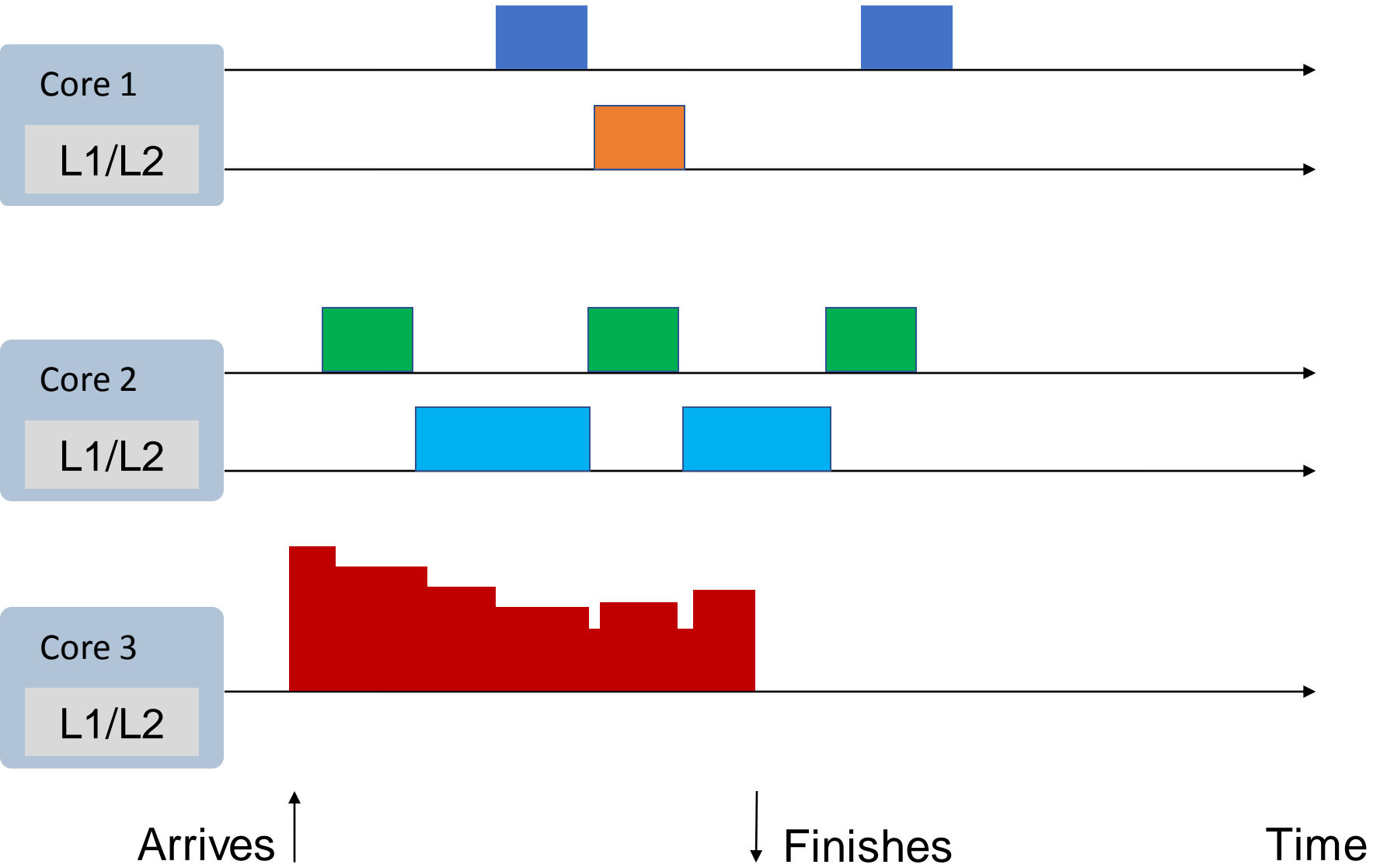
Problem: For each process, compute an upper bound on its response time.



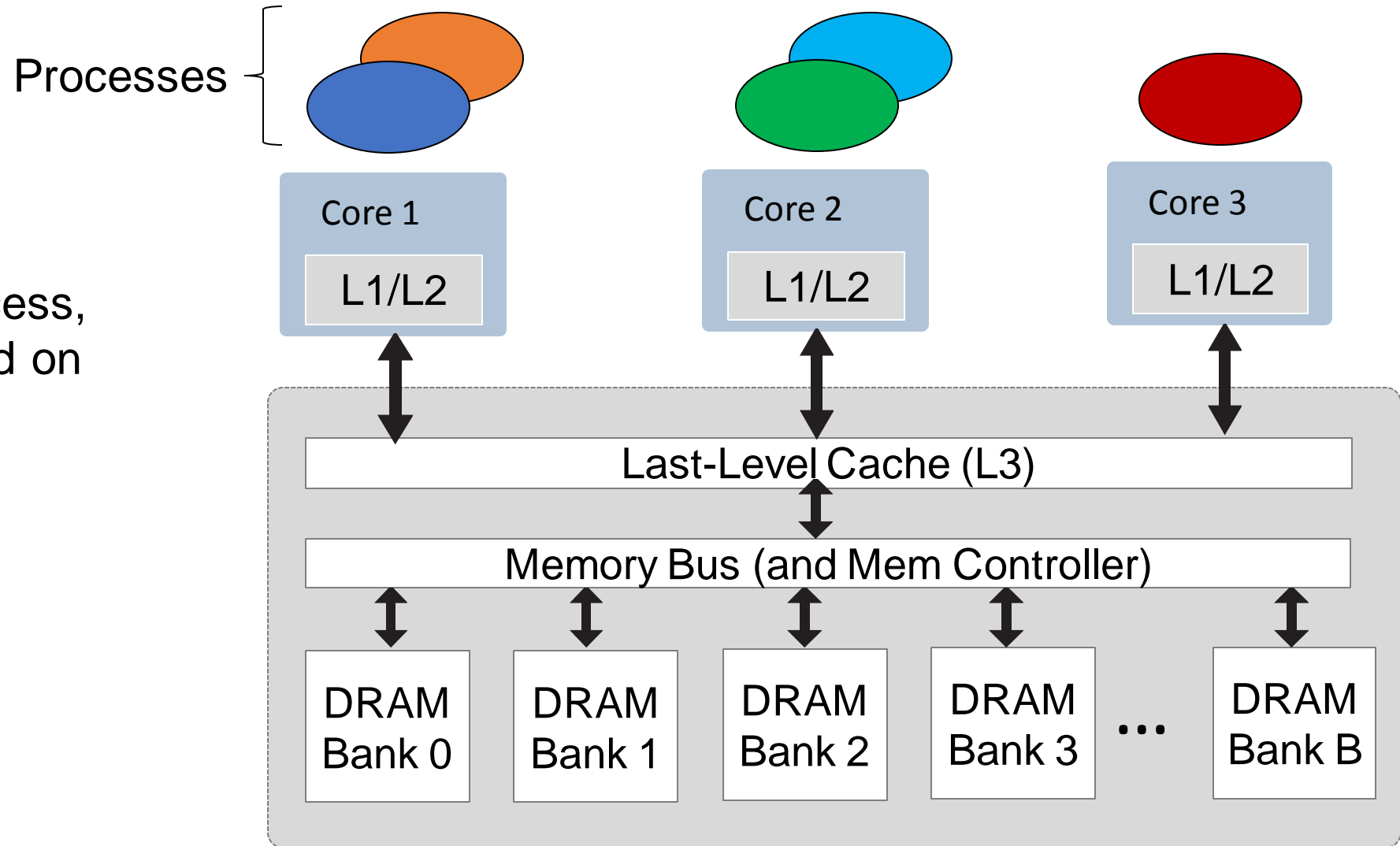
How Co-Runners Impact Speed of Execution



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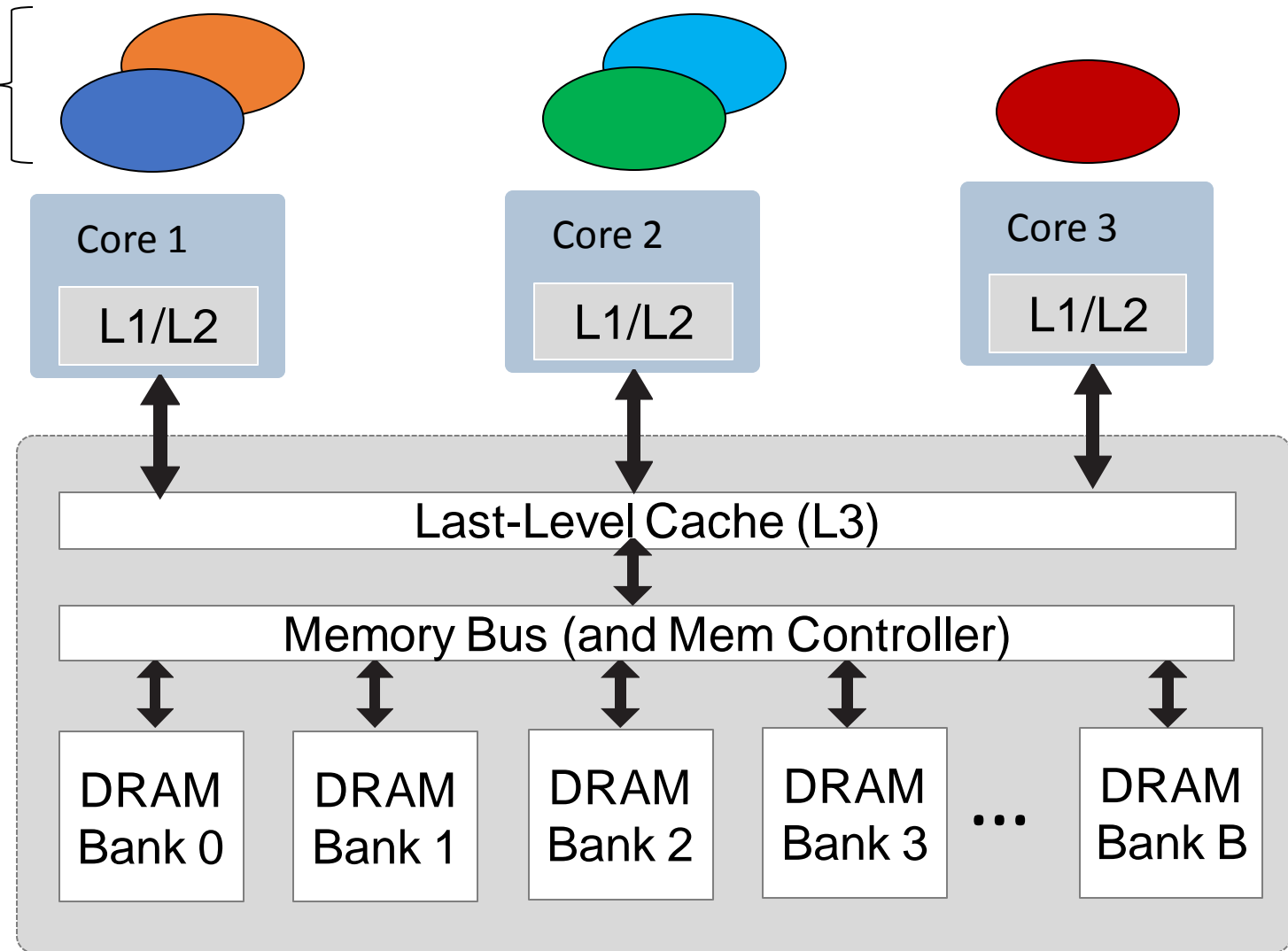
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Issues

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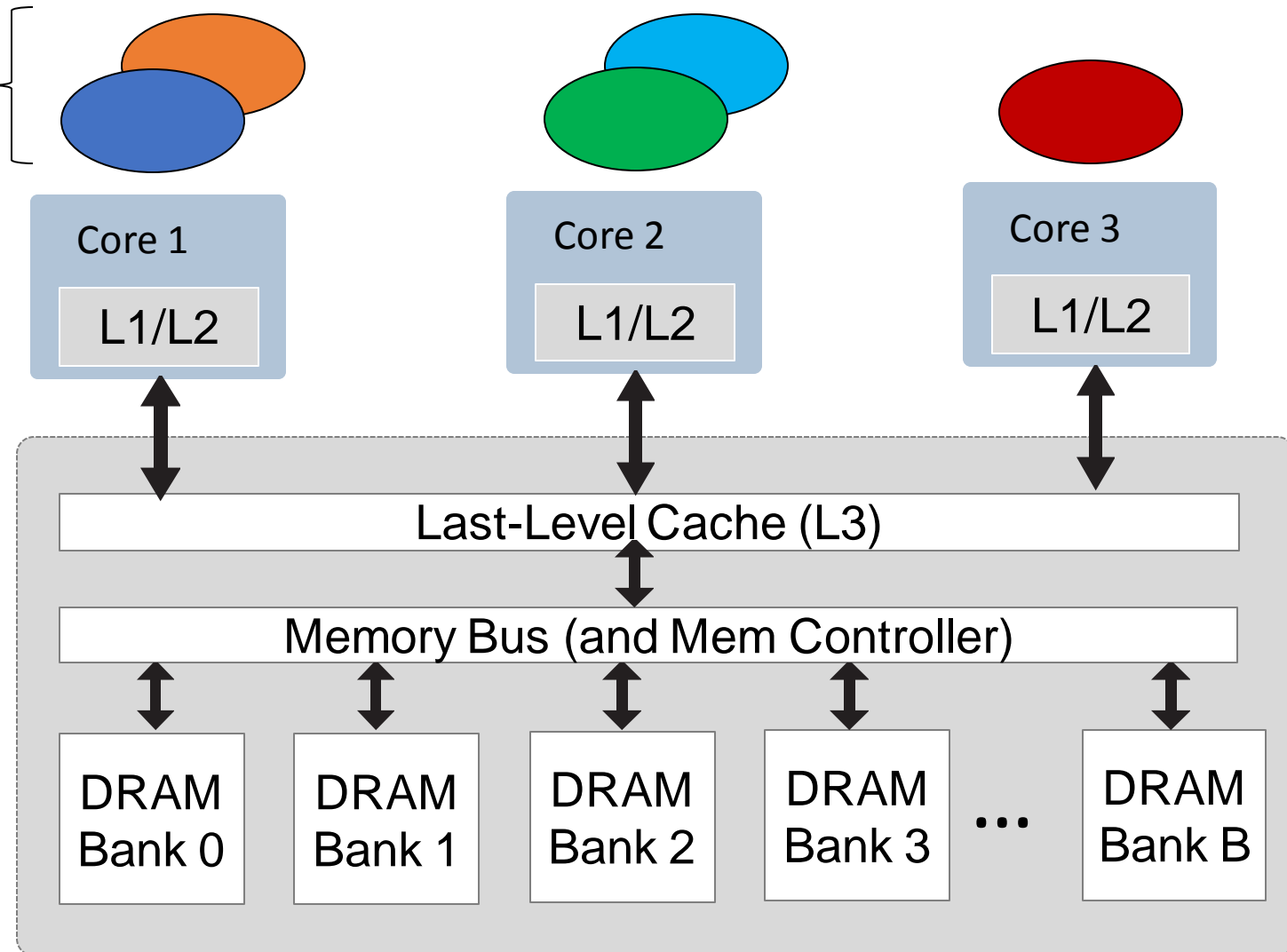
Processes



Issues

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- 103 times slowdown has been observed [Yun15].

Processes

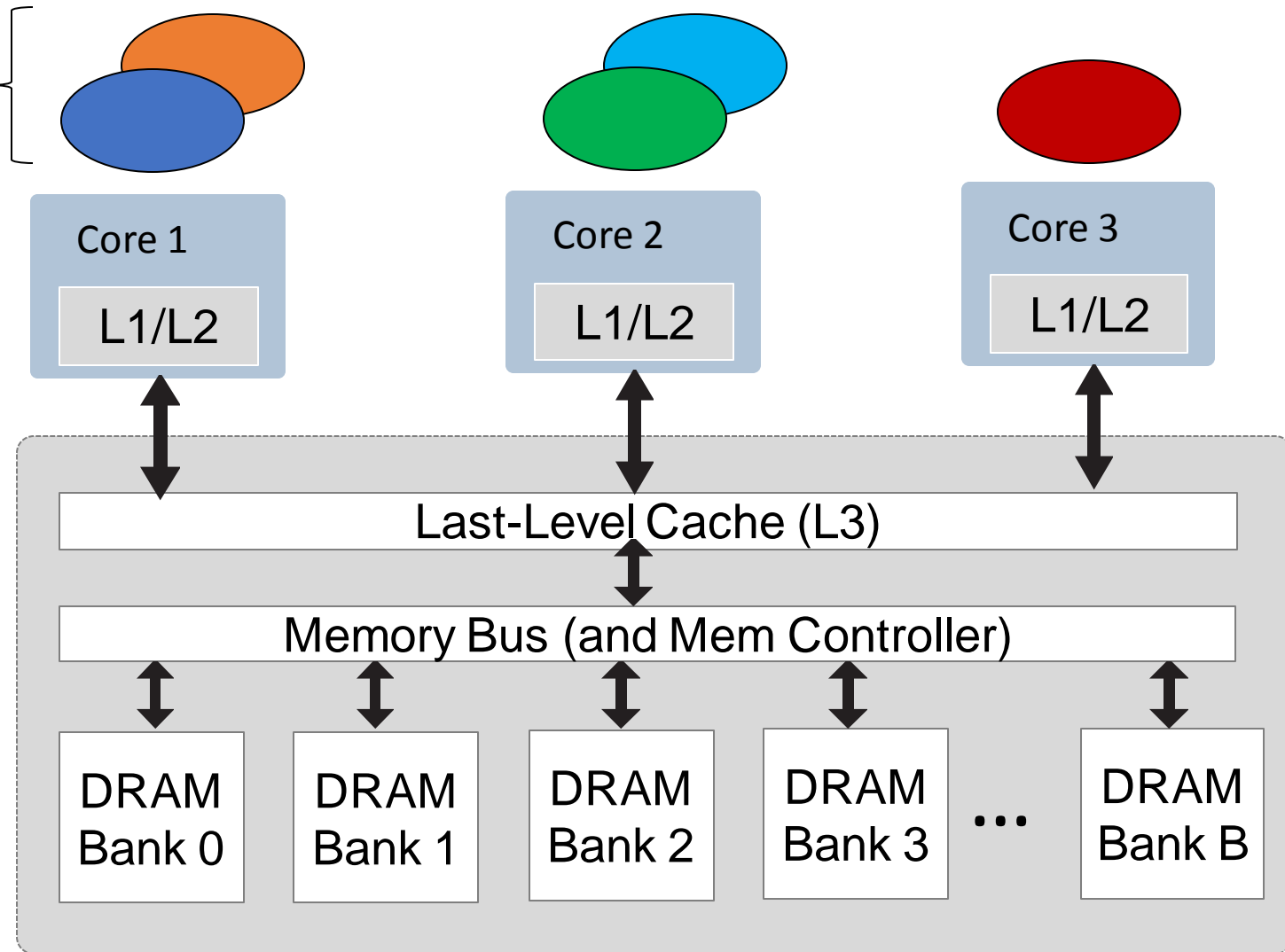


[Yun15] H. Yun and P. K. Valsan, "Evaluating the Isolation Effect of Cache Partitioning on COTS Multicore Platforms," OSPERT, 2015.

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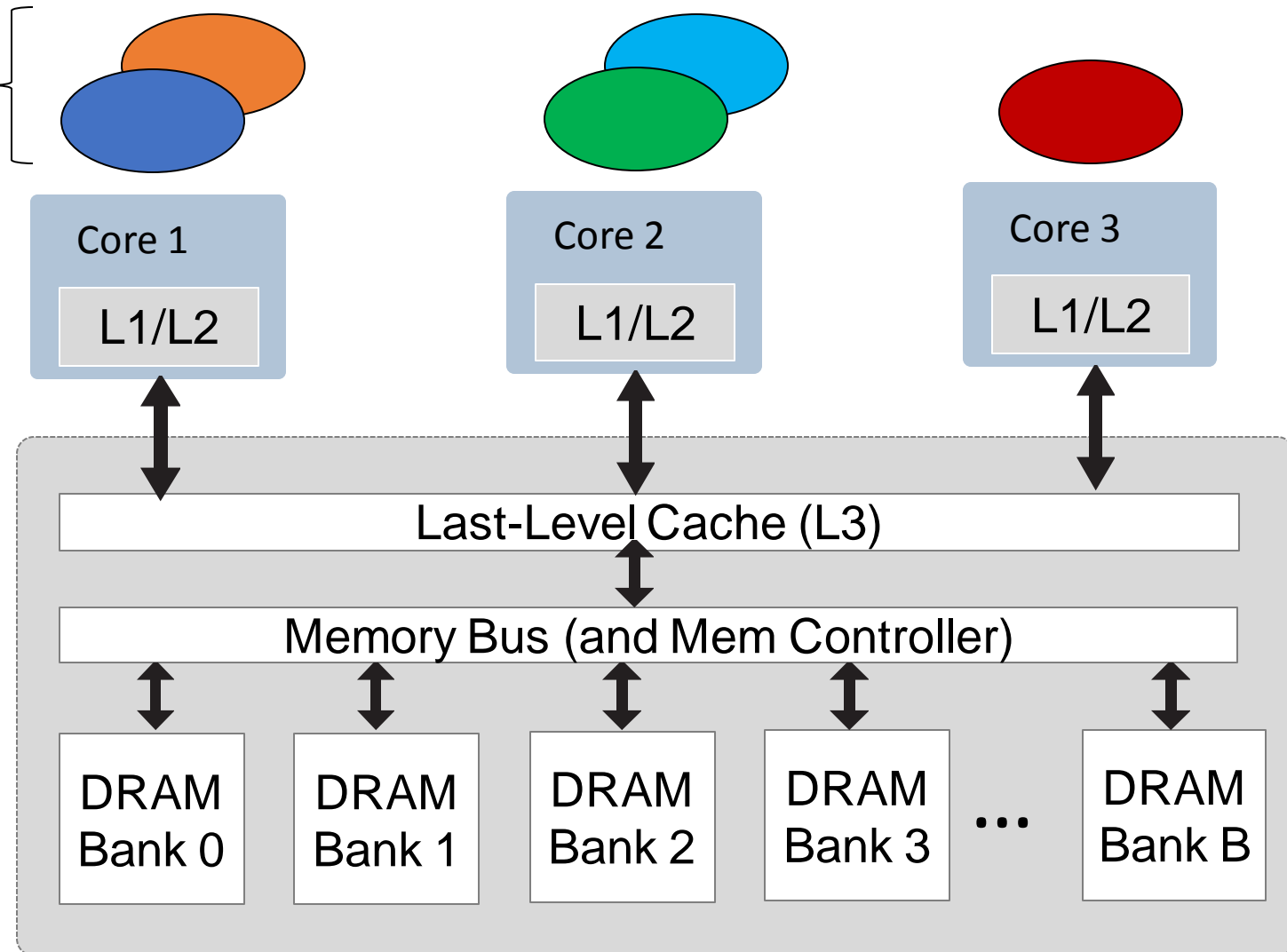
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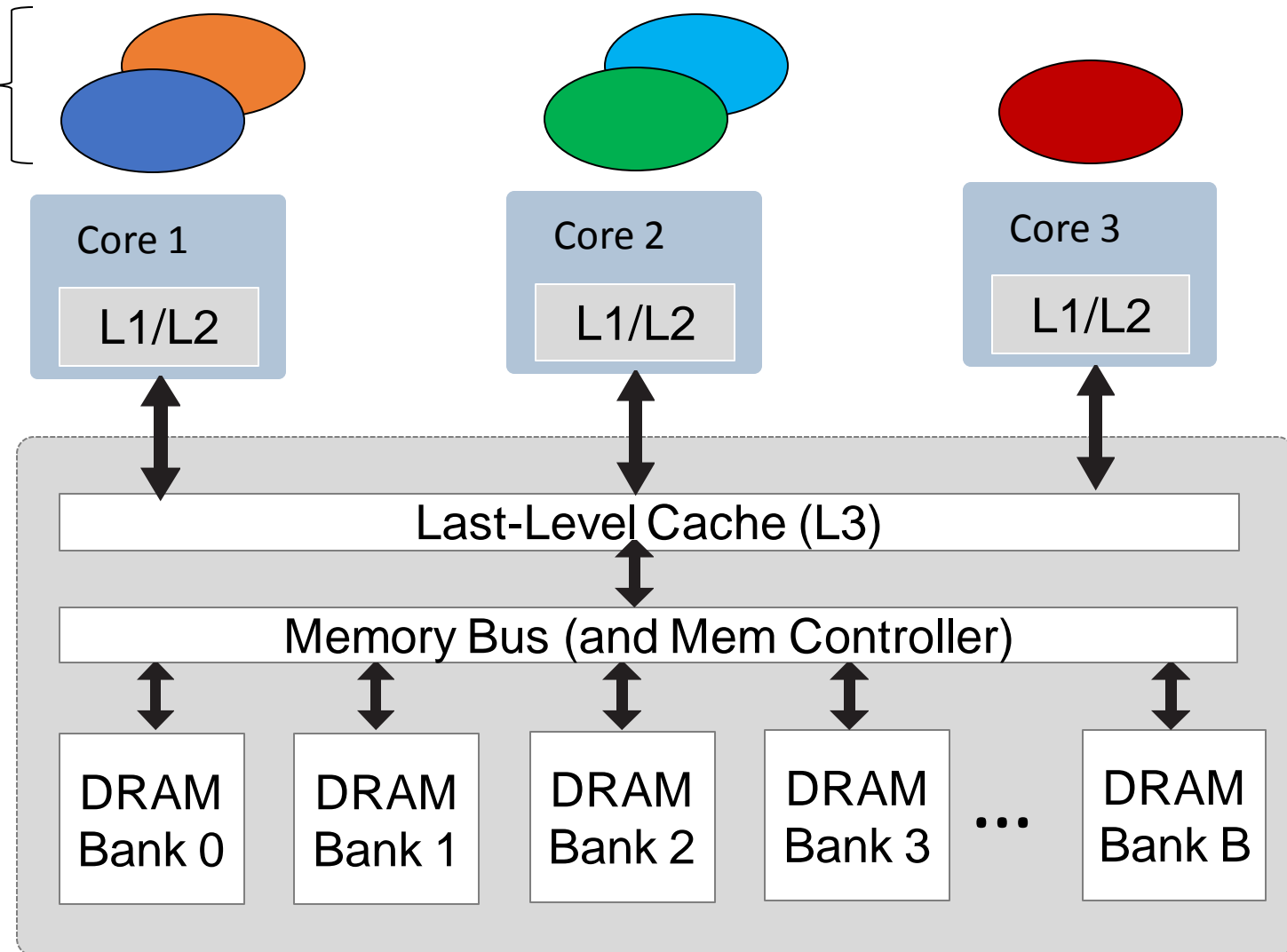
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