Google Workloads for Consumer Devices: Mitigating Data Movement Bottlenecks

Amirali Boroumand

Saugata Ghose, Youngsok Kim, Rachata Ausavarungnirun, Eric Shiu, Rahul Thakur, Daehyun Kim, Aki Kuusela, Allan Knies, Parthasarathy Ranganathan, Onur Mutlu

SAFARI Carnegie Mellon Google

SAMSUNG SEOUL NATIONAL UNIVERSITY ETH Zürich

Consumer Devices

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Consumer devices are everywhere!

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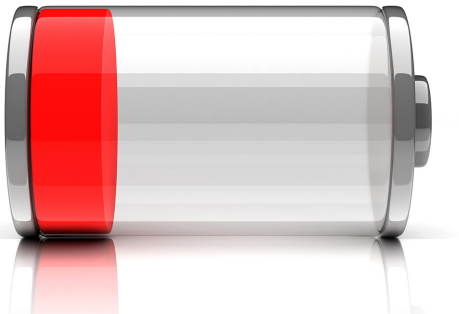
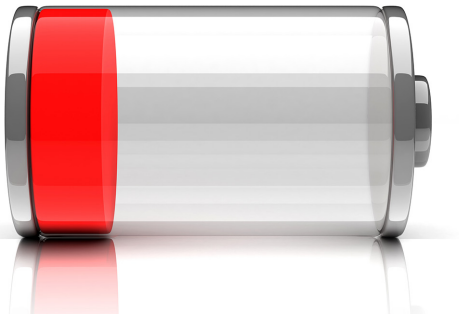


Consumer Devices


Consumer devices are everywhere!

Energy consumption is a first-class concern in consumer devices



Popular Google Consumer Workloads

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Chrome

Google's web browser

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Chrome

Google's web browser

TensorFlow Mobile

Google's machine learning framework

Popular Google Consumer Workloads

Chrome

Google's web browser

TensorFlow Mobile

Google's machine learning framework

VP9

YouTube

Video Playback

VP9

YouTube

Video Capture

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Video Playback

Google's **video codec**

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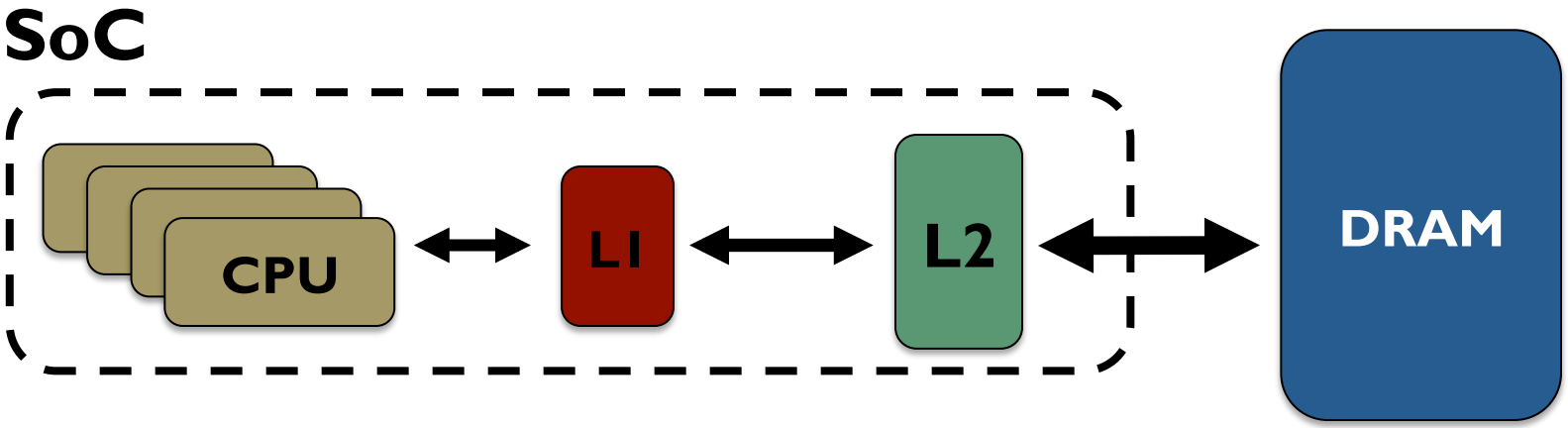
Video Capture

Google's **video codec**

Energy Cost of Data Movement



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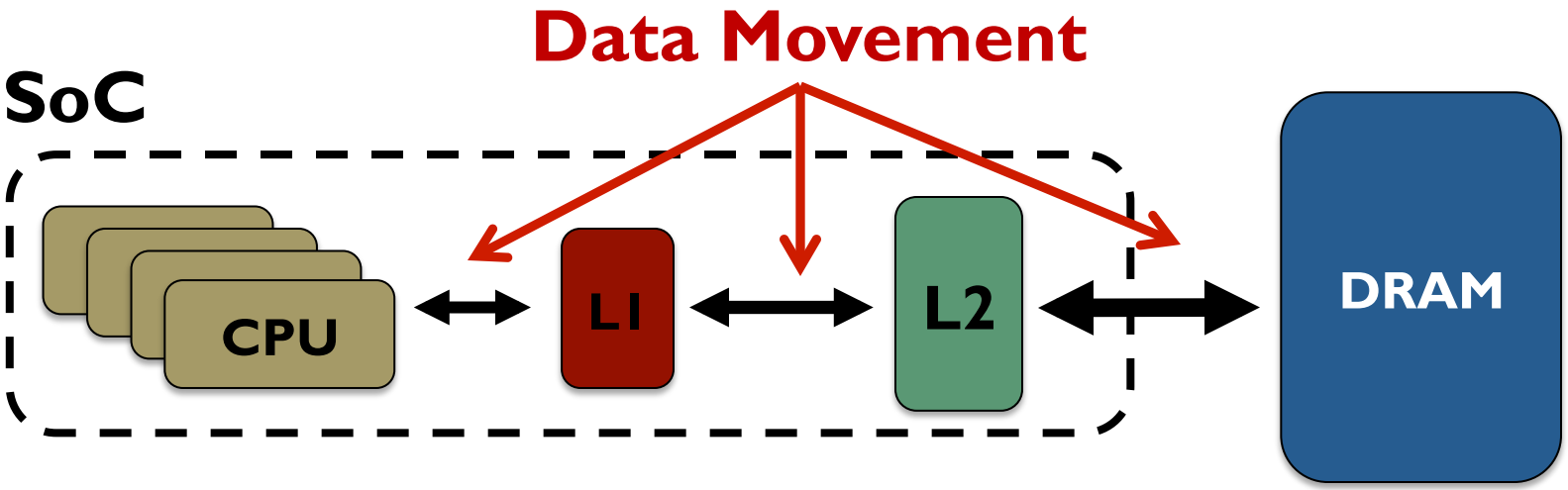
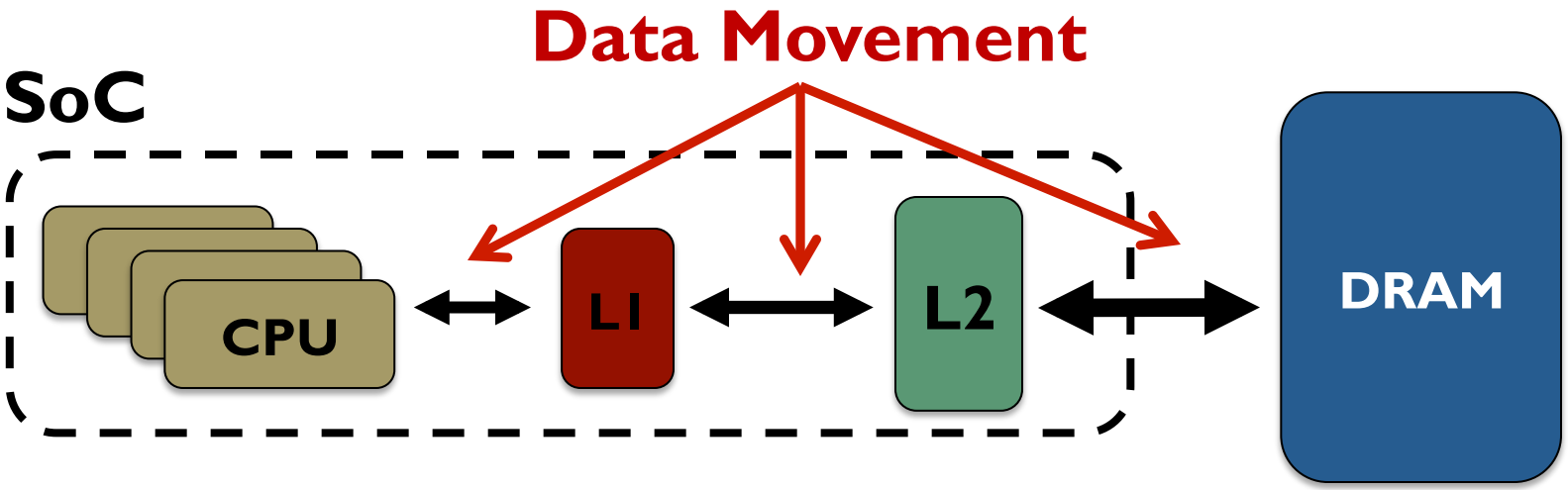


Energy Cost of Data Movement

1st key observation: 62.7% of the total system energy is spent on data movement



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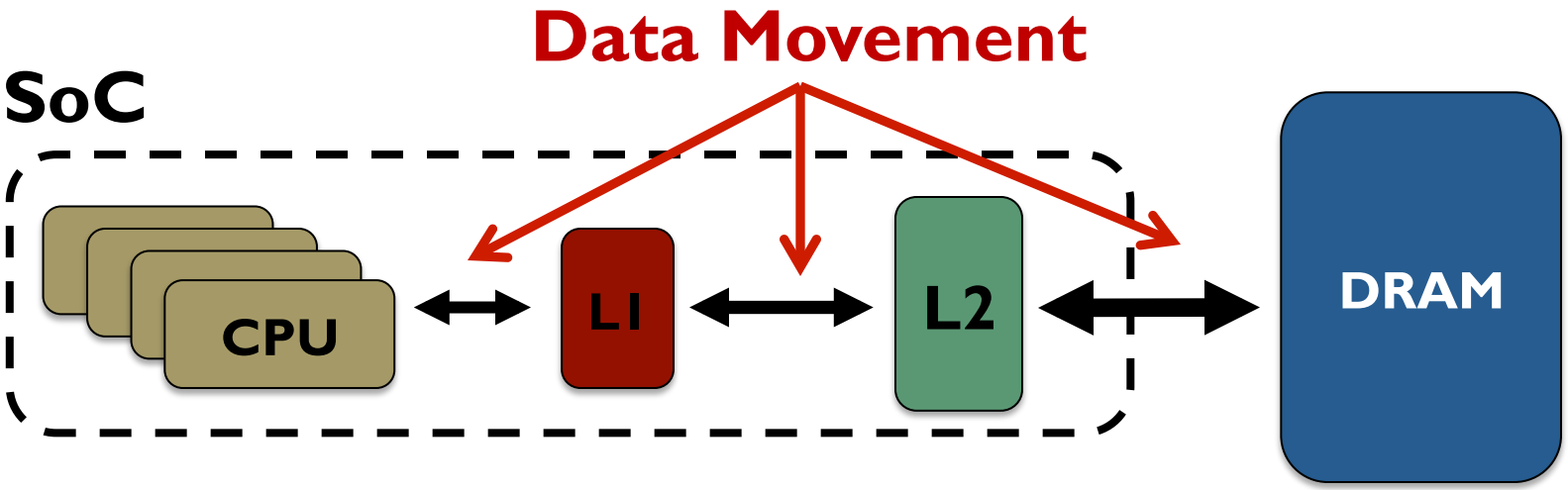

Potential solution: move computation close to data

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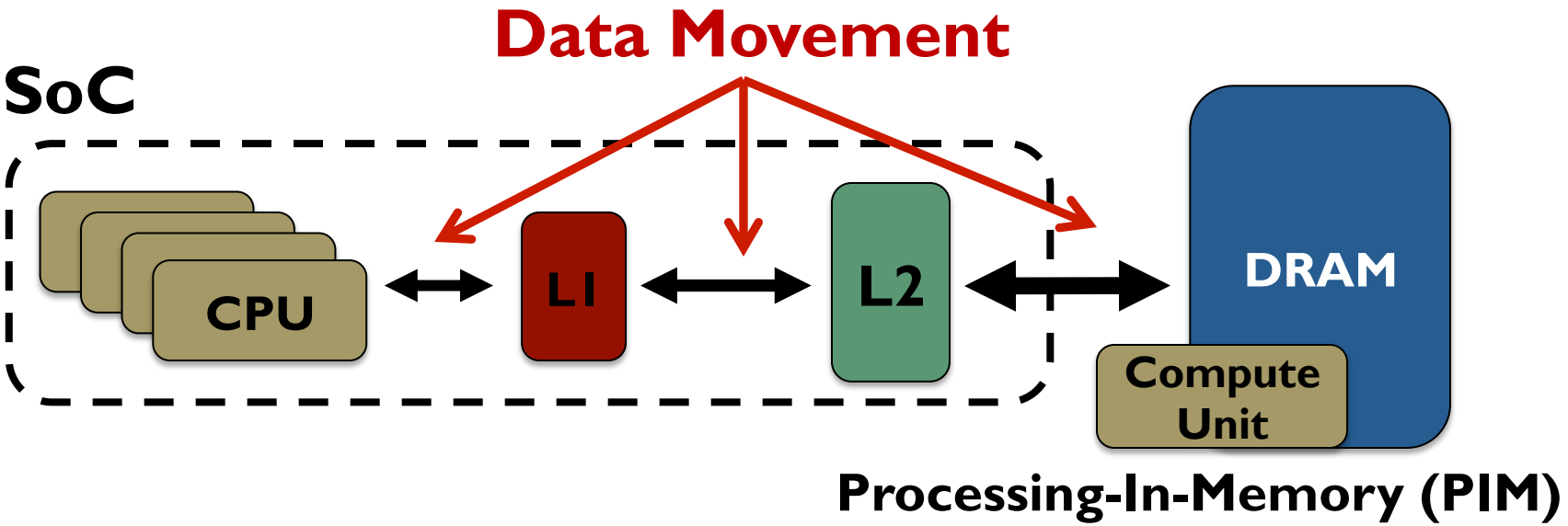

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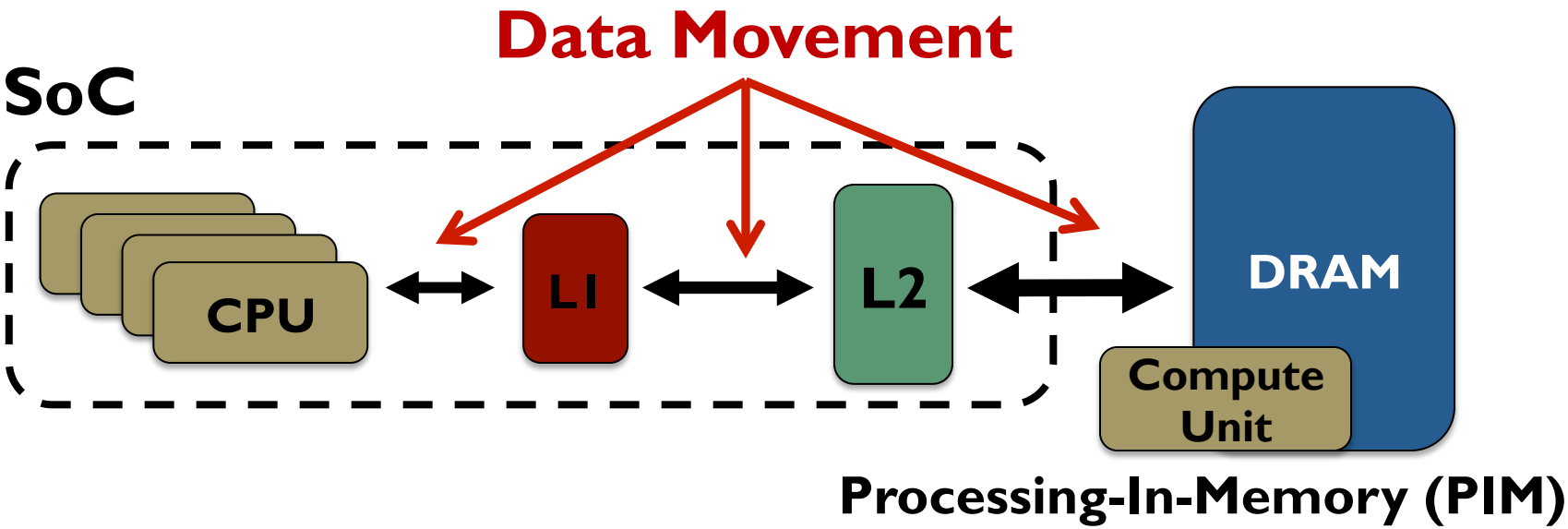

Potential solution: move computation close to data

Challenge: limited area and energy budget

Using PIM to Reduce Data Movement

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PIM Core

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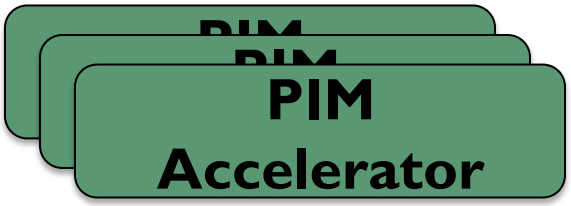
Small fixed-function accelerators



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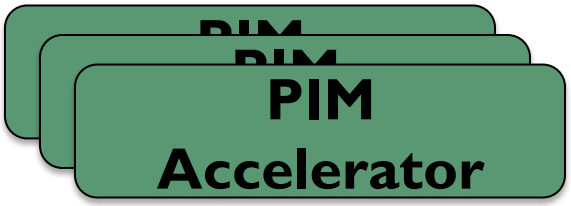

Offloading to PIM logic reduces energy and improves performance, on average, by 55.4% and 54.2%

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Location: Virgina EF

Time: 11:10 AM

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