Research Infrastructures for Accelerator-Centric Architectures

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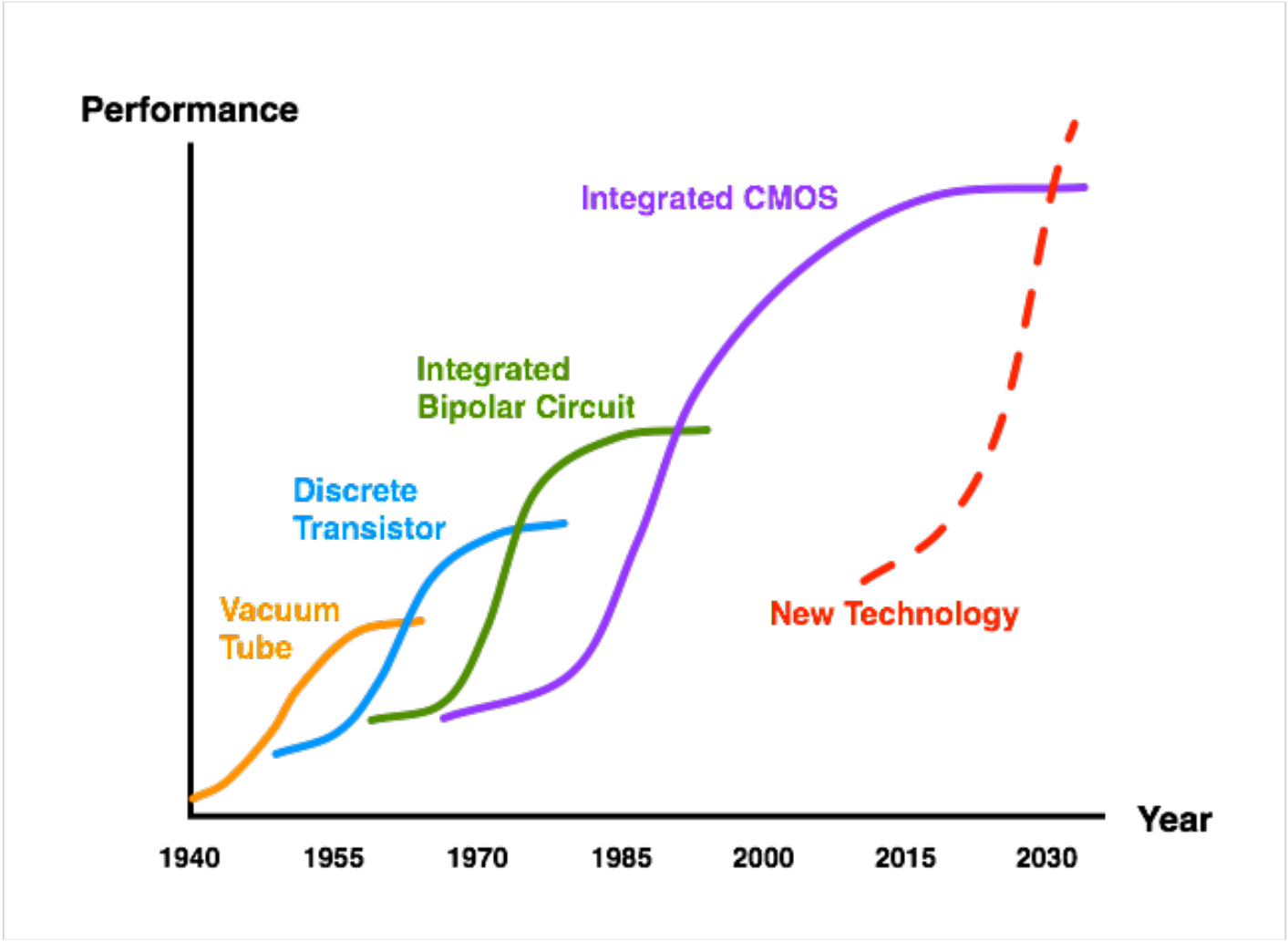
Tutorial Outline

Time	Topic
8:30 am – 9:00 am	**Introduction**
9:00 am – 10:00 am	Pre-RTL Simulation Framework: Aladdin
10:00 am – 10:30 am	Break
10:30 am – 11:00 am	Workload Characterization Tool: WIICA
11:00 am – 12:00 pm	CAD & Benchmarks: HLS & MachSuite
12:00 pm – 2:00 pm	Lunch
2:00 pm – 3:00 pm	Embedded Keynote Talk: Mark Horowitz (Stanford)
3:00 pm – 3:30 pm	Accelerator Selection Tool: Sigil
3:30 pm – 4:00 pm	Break
4:00 pm – 5:00 pm	Hands-on Exercise

CMOS Technology Scaling



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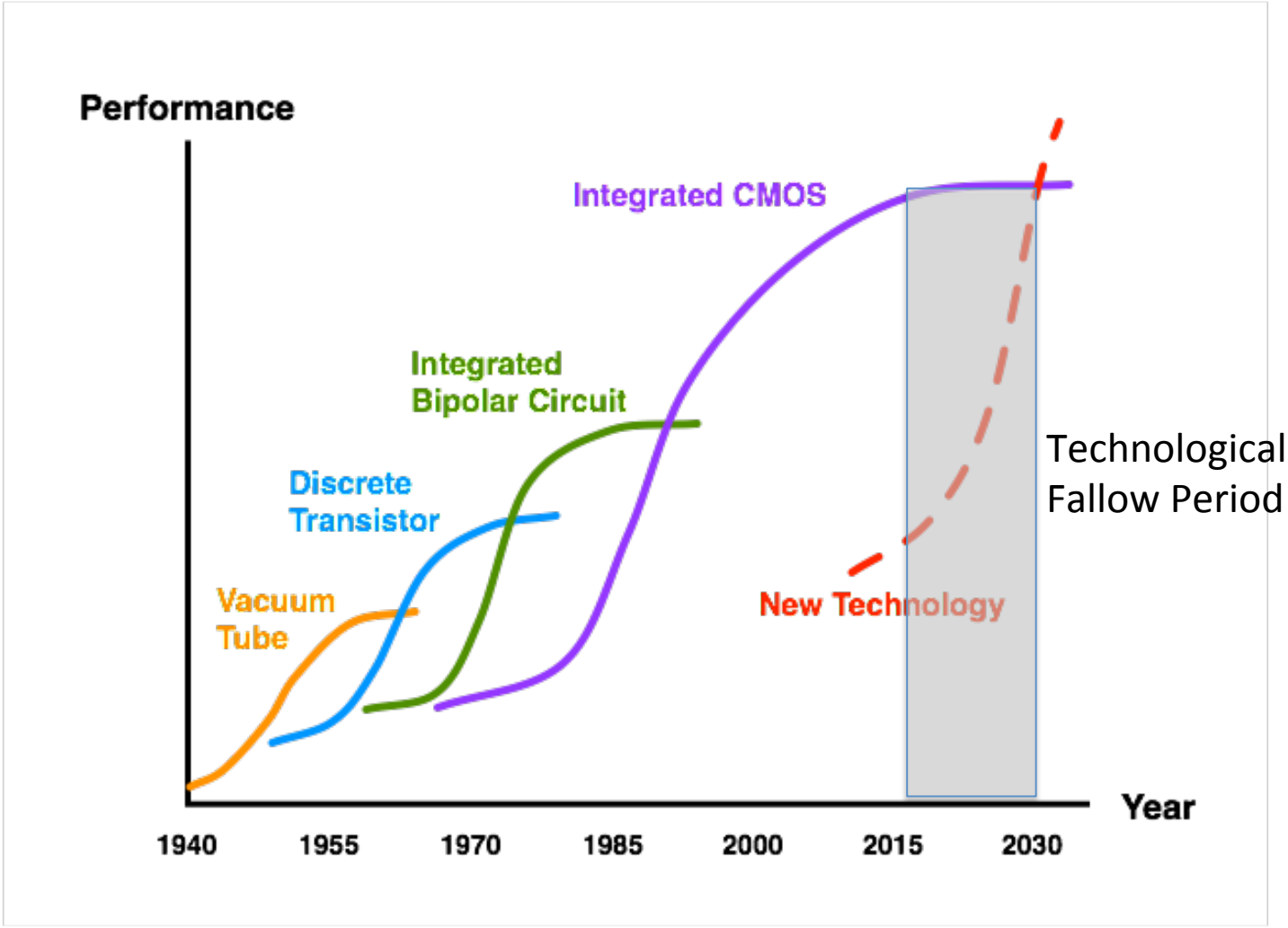
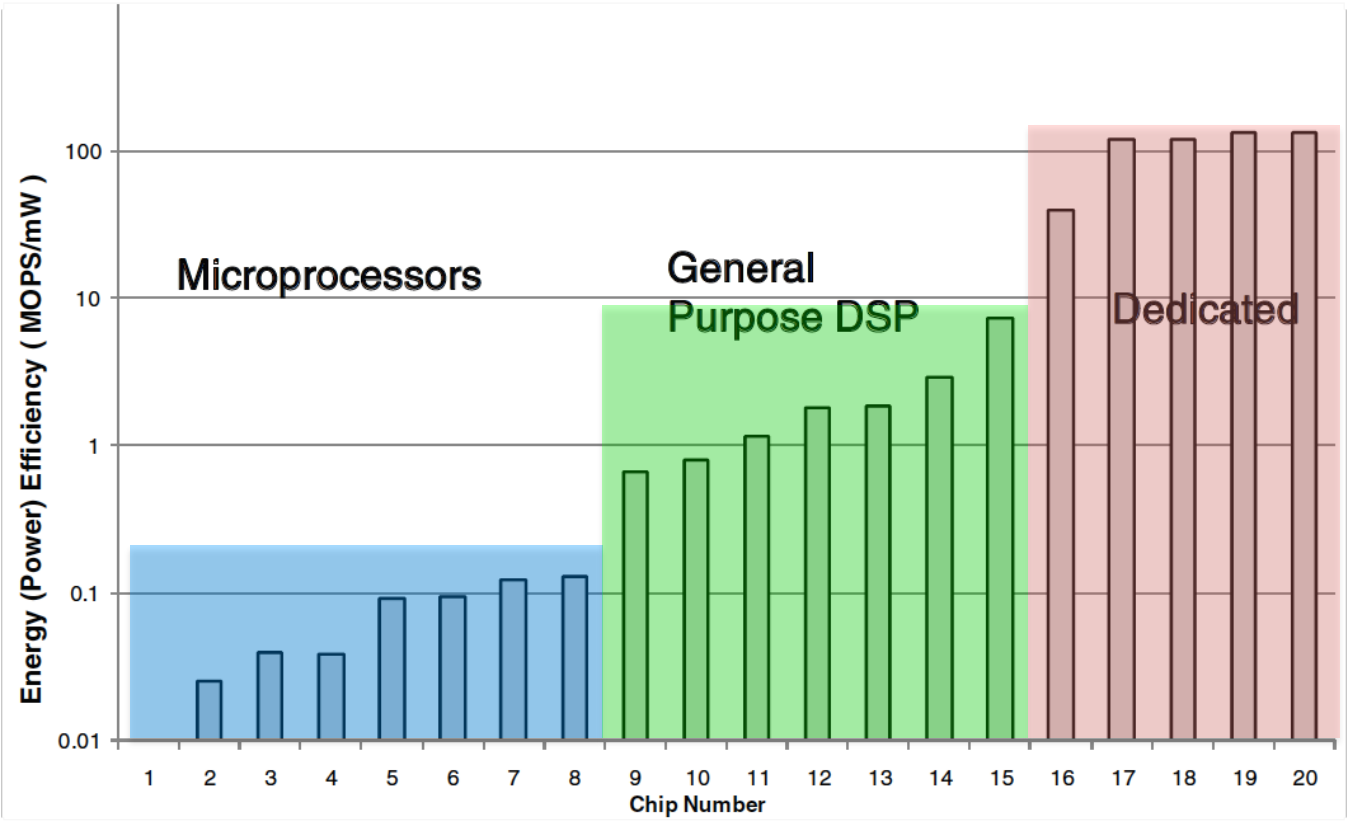


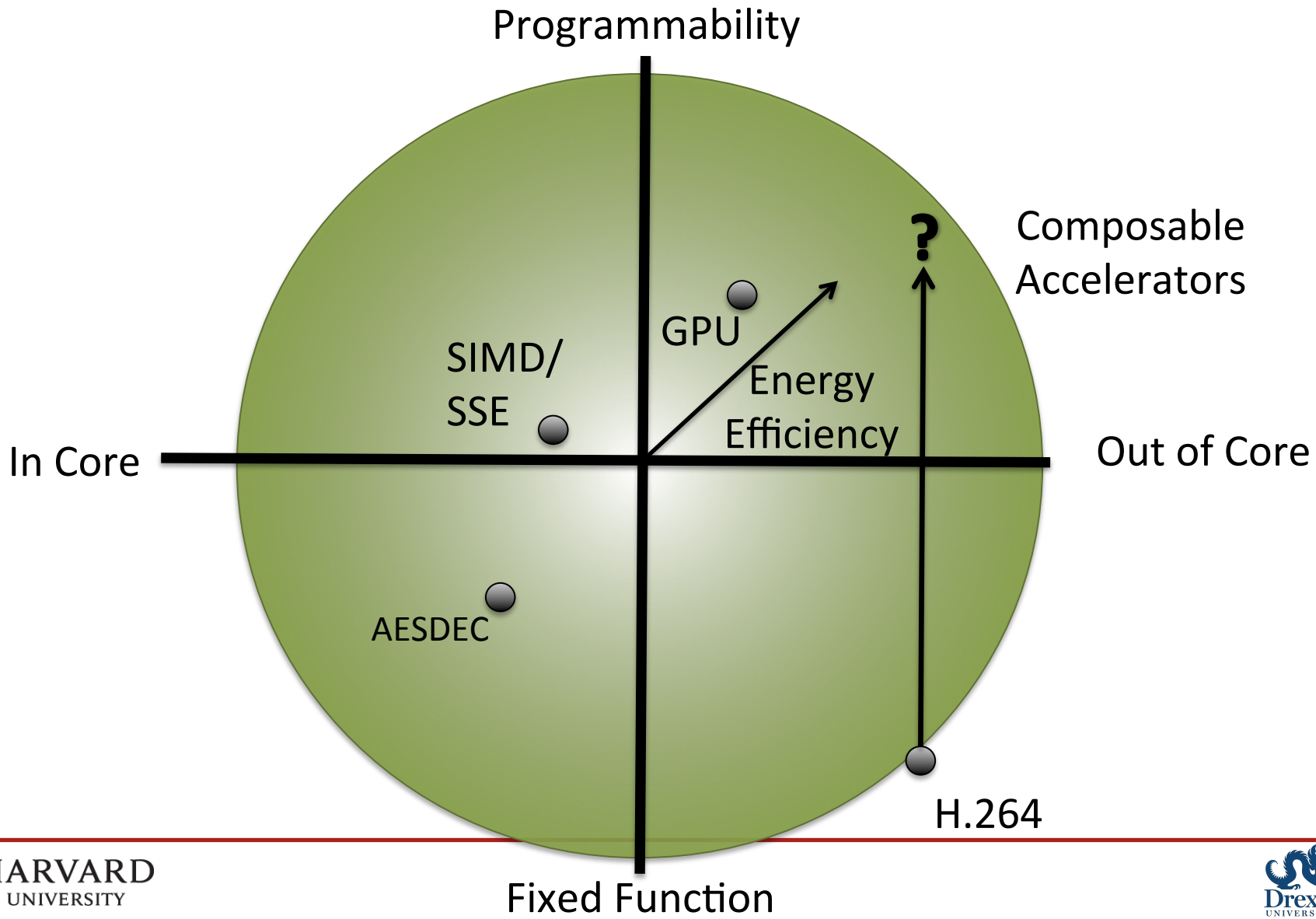
Potential for Specialized Architectures



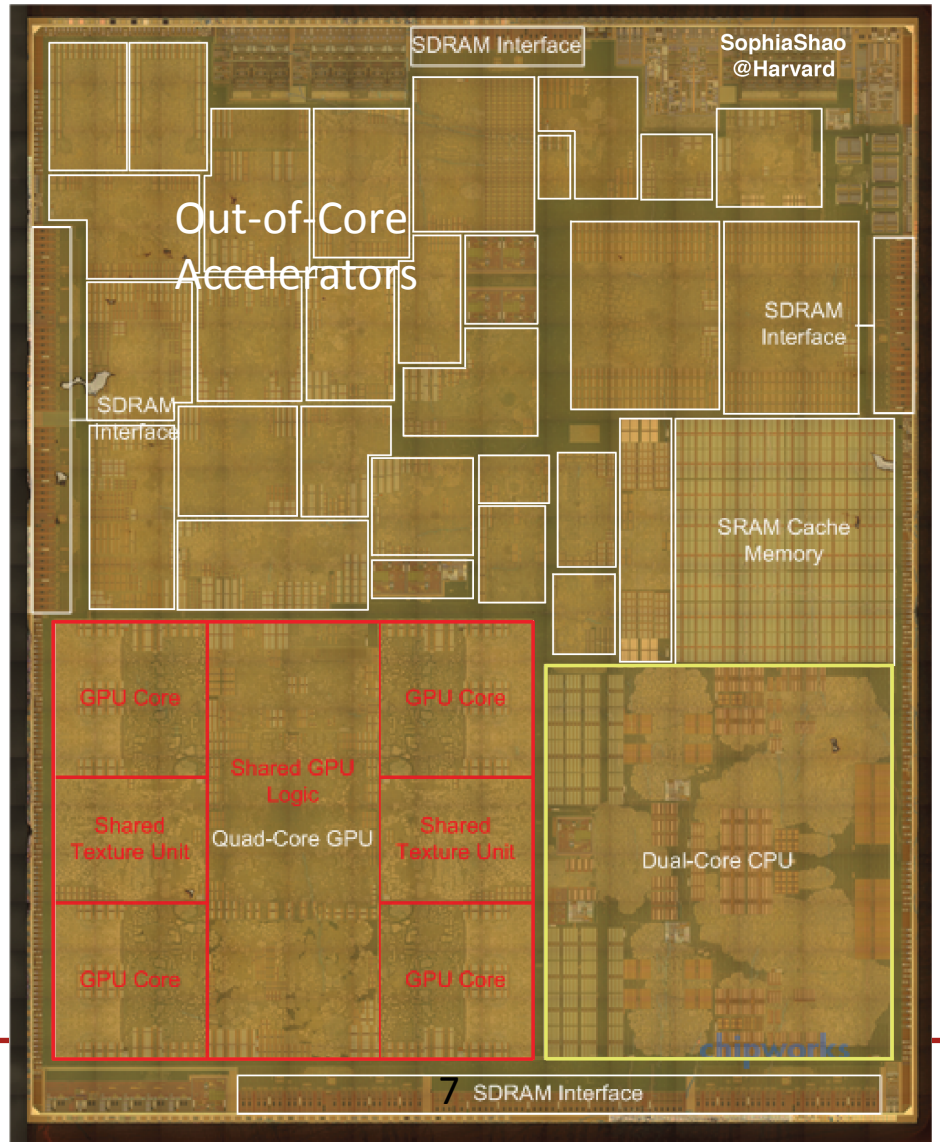
16	Encryption
17	Hearing Aid
18	FIR for disk read
19	MPEG Encoder
20	802.11 Baseband

[Brodersen and Meng, 2002]

Beyond Homogeneous Parallelism



Cores, GPUs, and Accelerators: Apple A8 SoC



[Die photo from Chipworks]
[Accelerators annotated by Sophia Shao @ Harvard]

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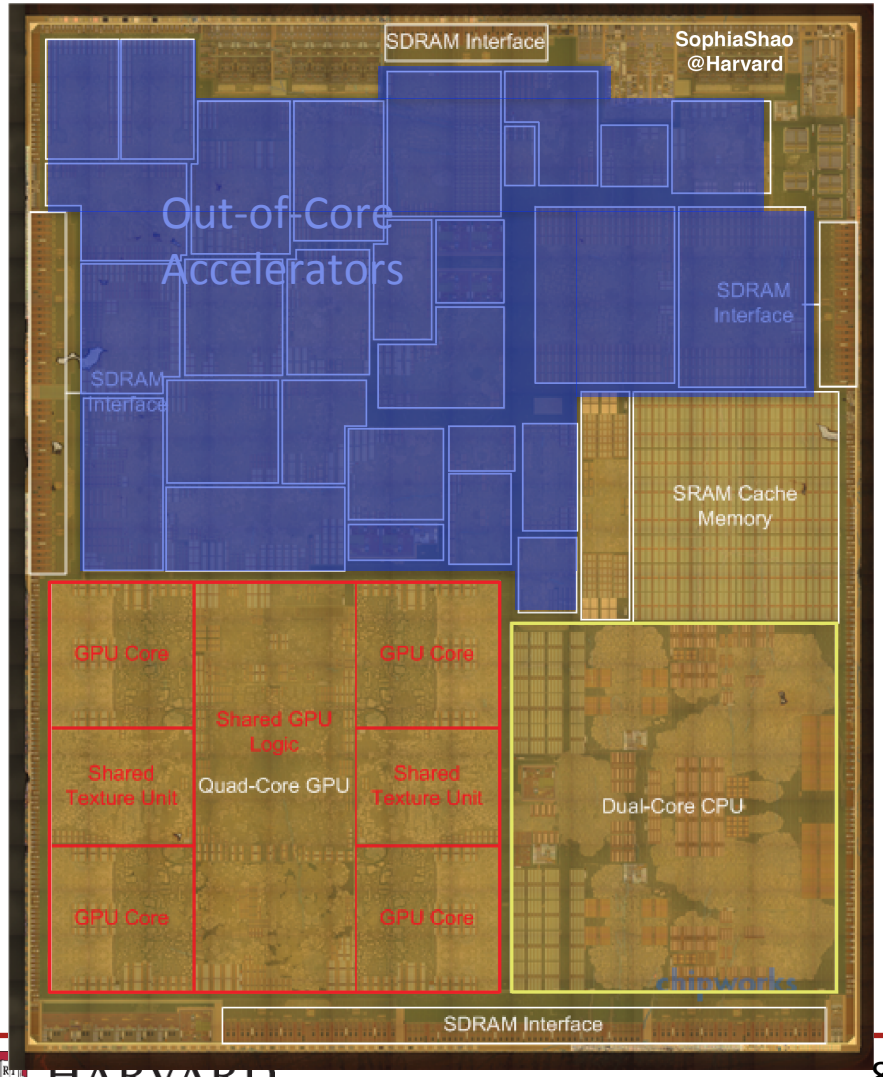

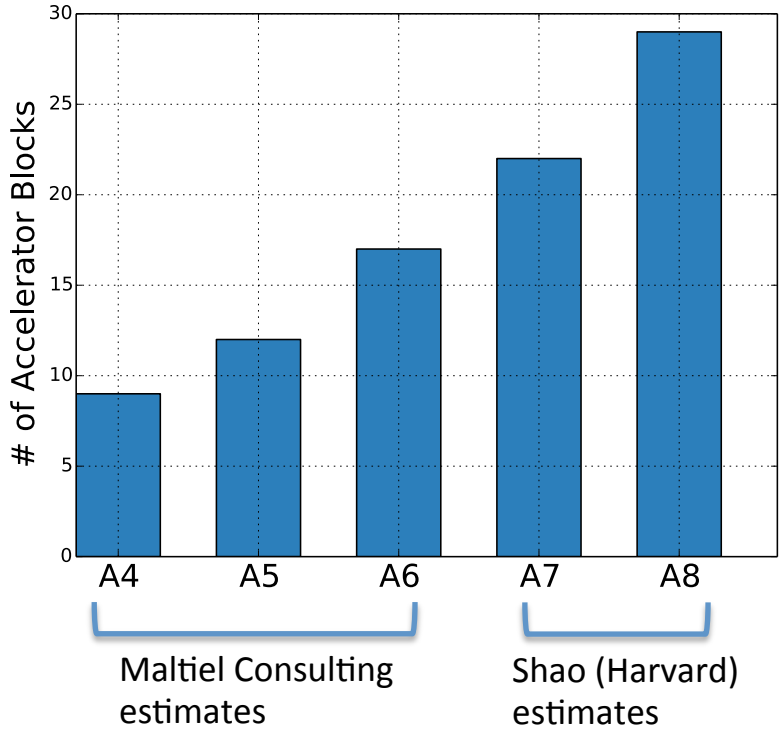

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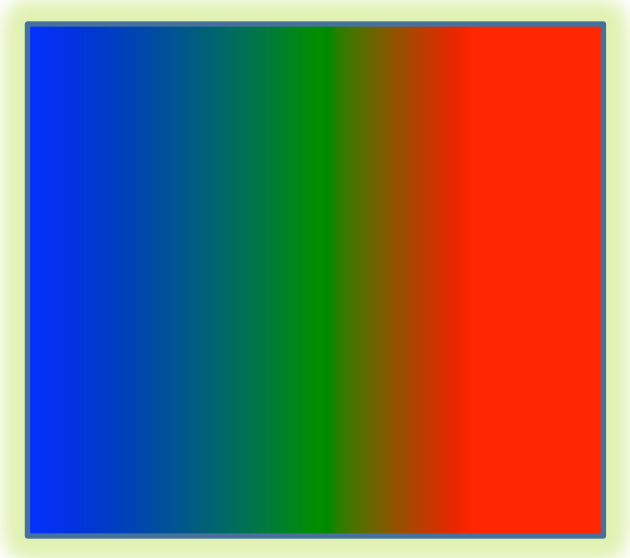
Challenges in Accelerators

- Flexibility
  - Fixed-function accelerators are only designed for the target applications.

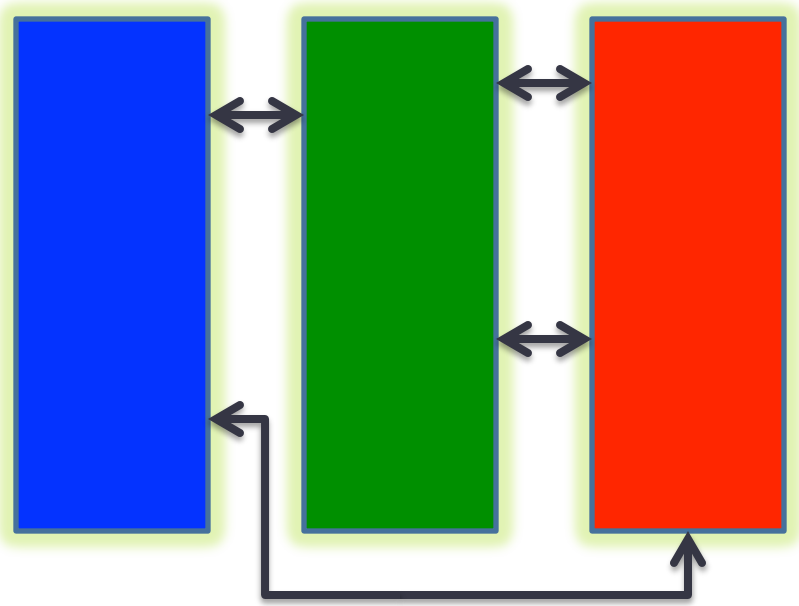
Composable Customization

Monolithic Hardware Accelerator



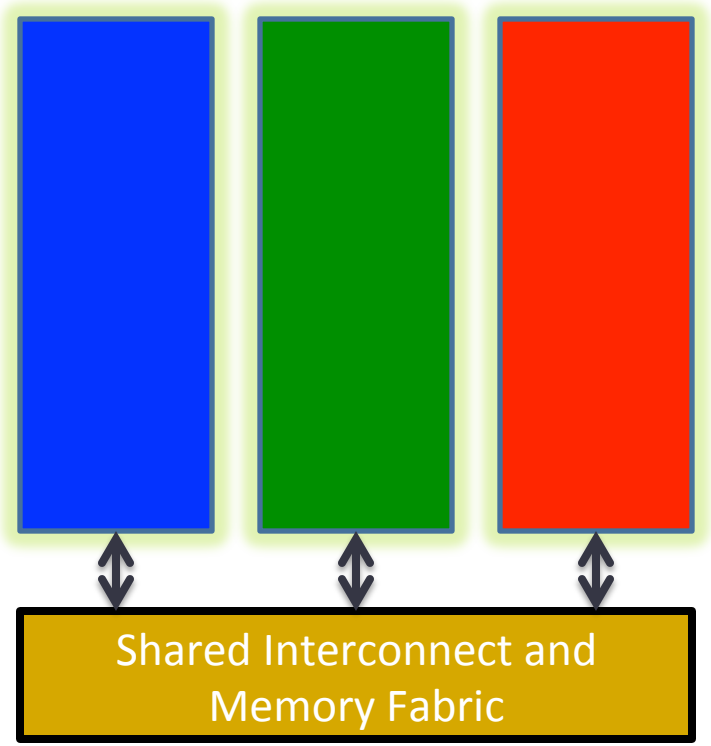
Composable Customization

Composed Accelerator with sub-blocks



Composable Customization

Composed Accelerator w/ Architectural Support



Composable Customization

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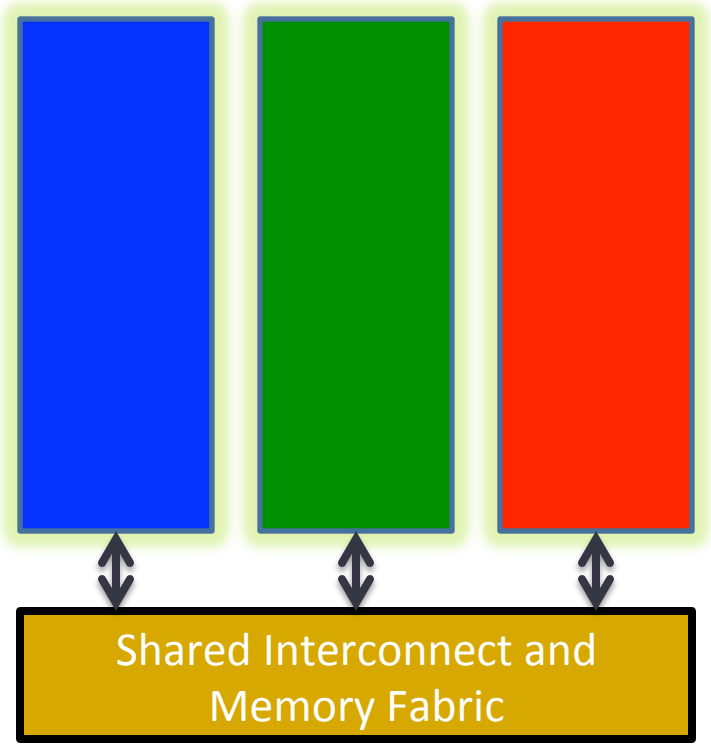
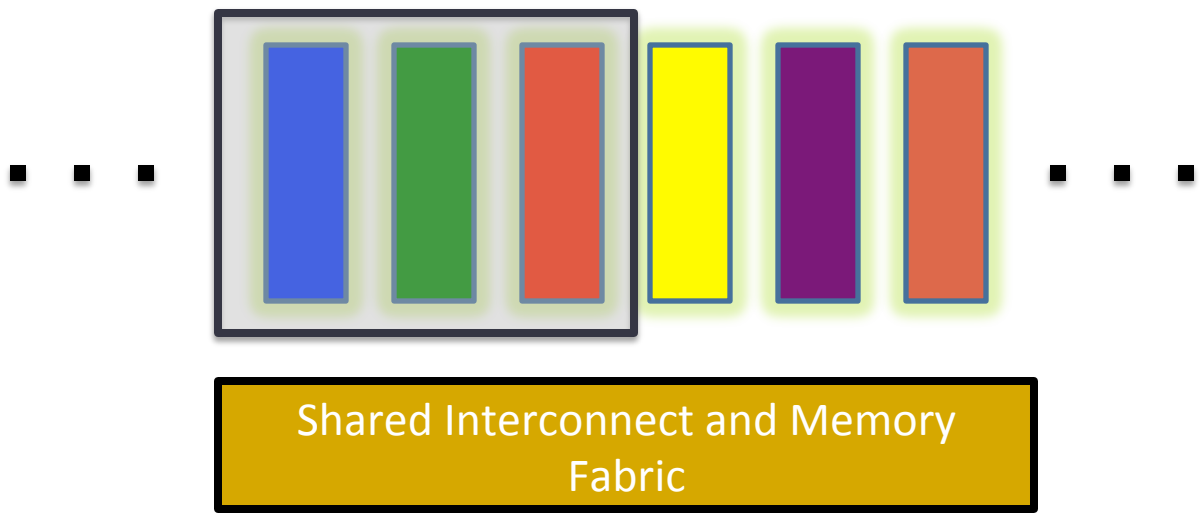


Example:
"Accelerator Store"
Lyons et al. TACO'12

Composable Customization

Composed Accelerator w/ Architectural Support



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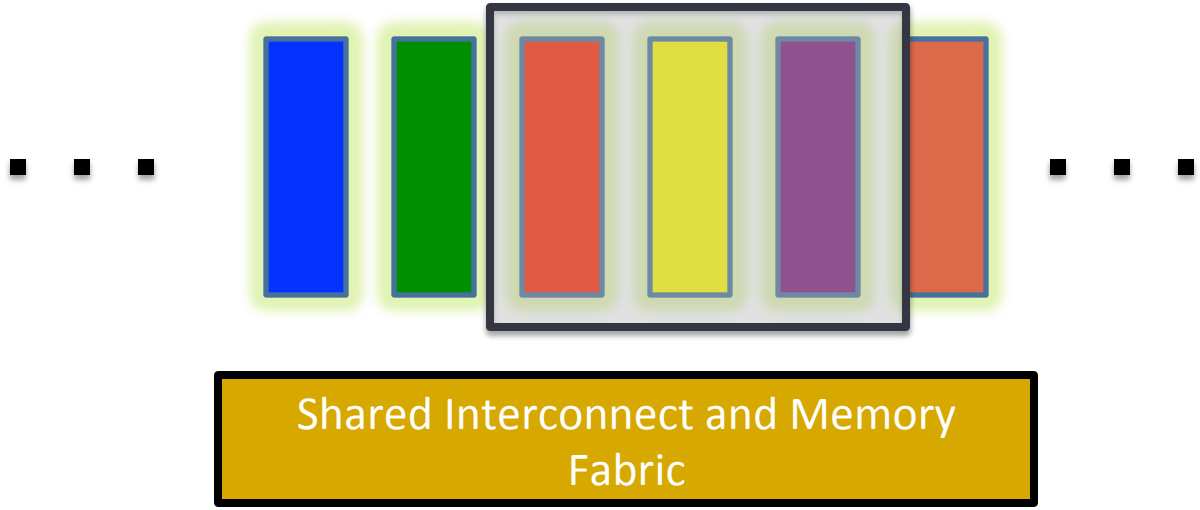
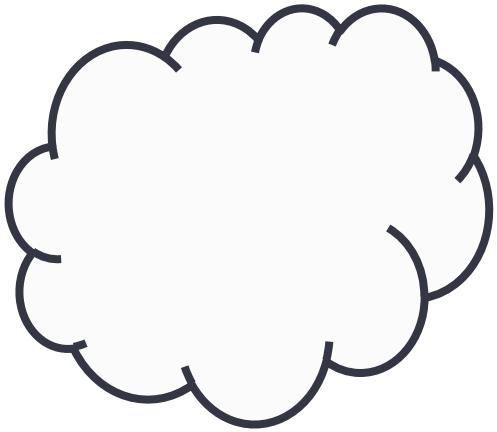


Composable Accelerators Provide Application Flexibility

Is this general-purpose?

General-purpose workloads are far less regular



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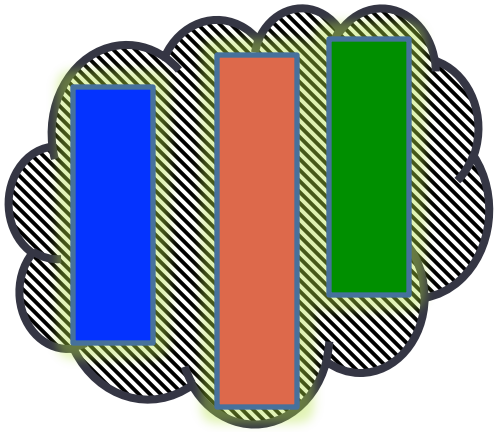

Shared Interconnect and Memory Fabric

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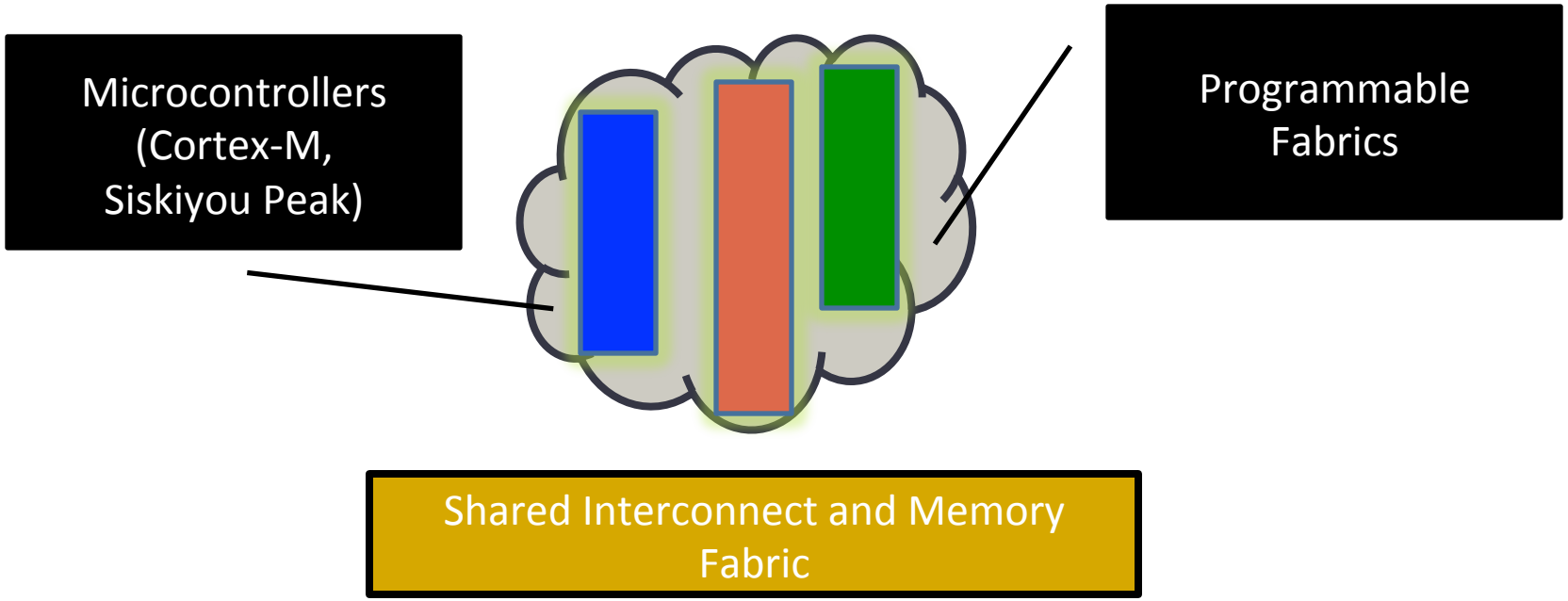
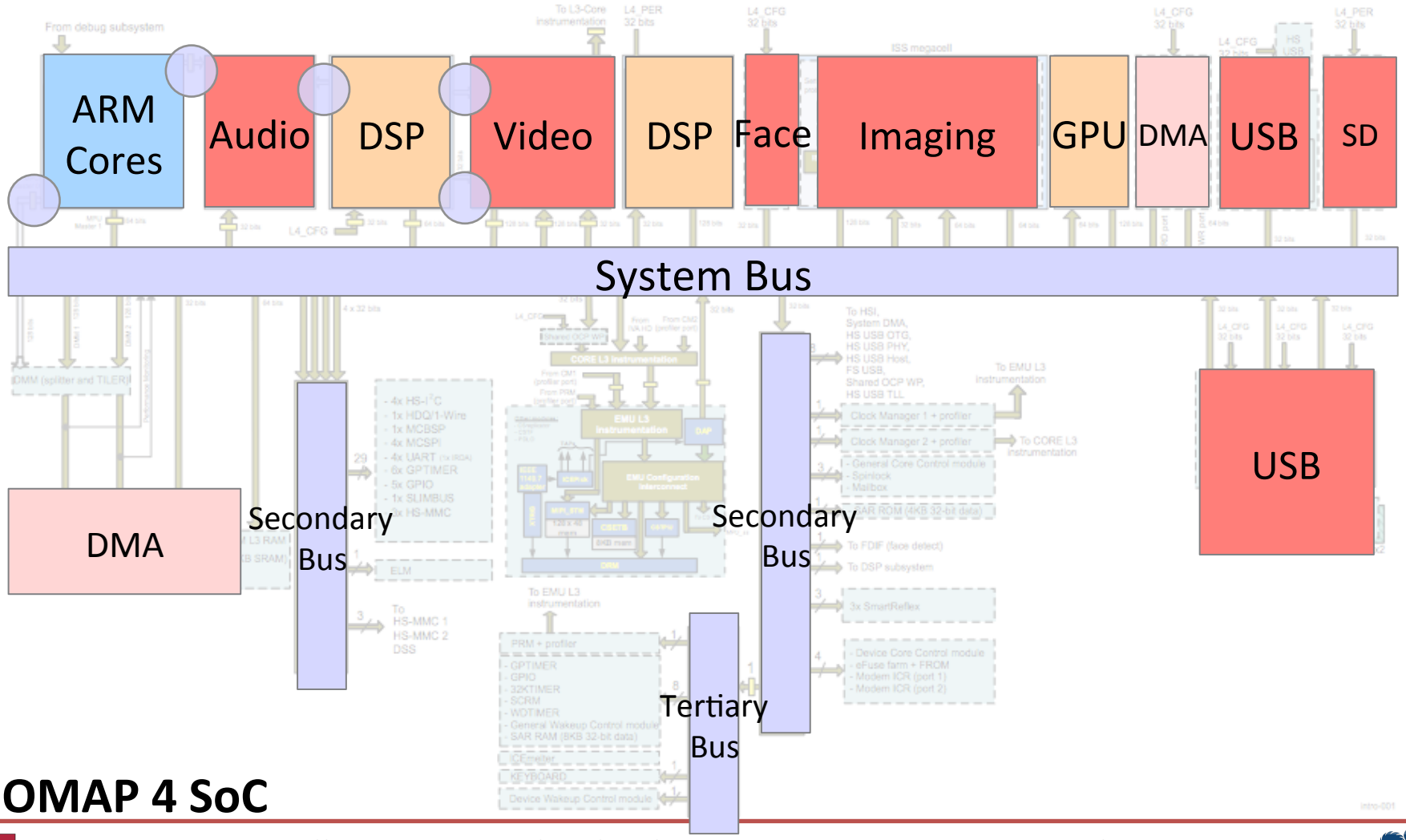


Embed programmability into the accelerator fabric!

Challenges in Accelerators

- Flexibility
  - Fixed-function accelerators are only designed for the target applications.
- Programmability
  - Today's accelerators are explicitly managed by programmers.

Today's SoC



OMAP 4 SoC

http://www.anandtech.com/show/4551/motorola-droid-3-review-third-times-a-charm/10

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- Programmability
  - Today's accelerators are explicitly managed by programmers.
- Design Cost
  - Accelerator (and RTL) implementation is inherently tedious and time-consuming.