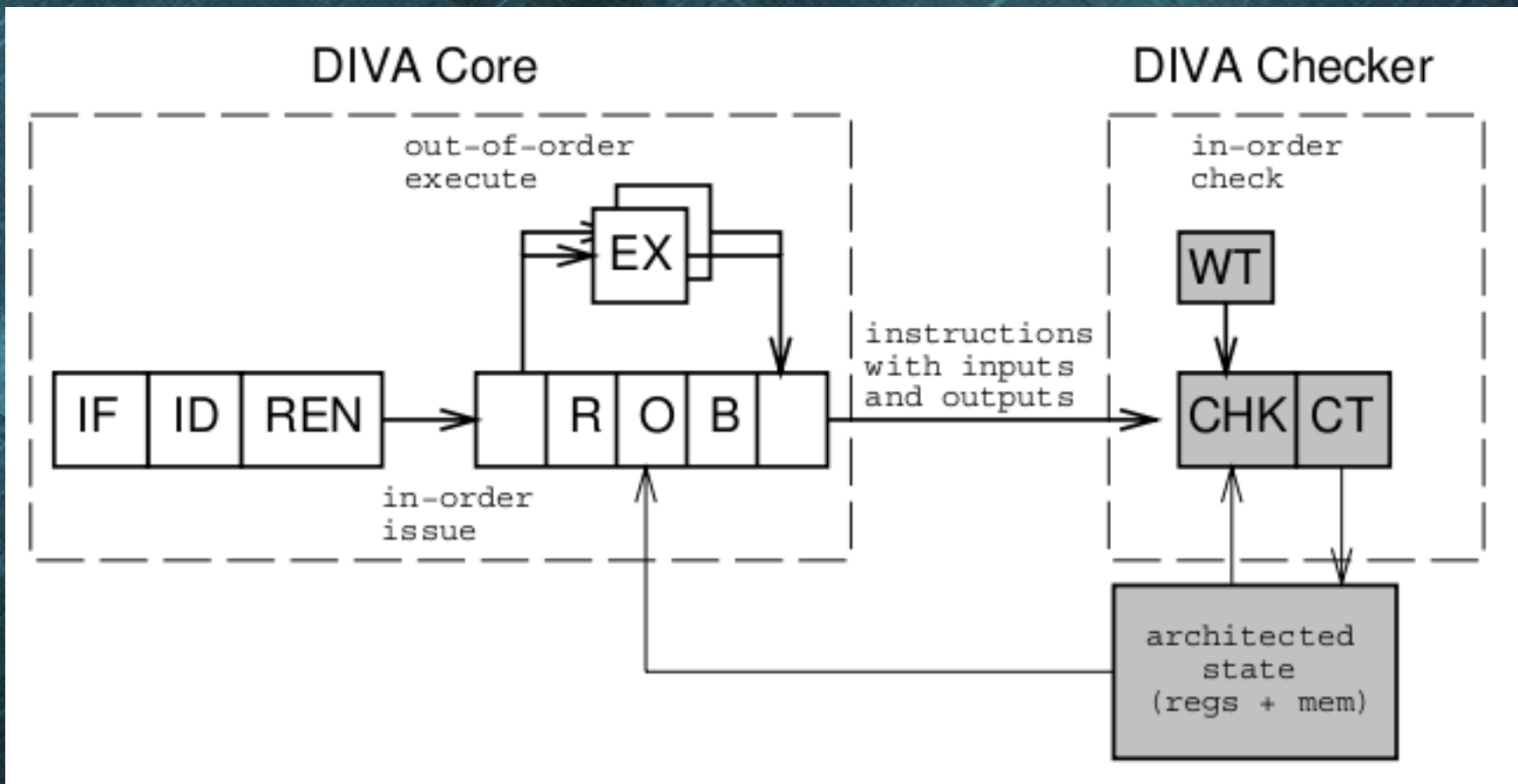


Decoupled Access/Execute Computer Architectures

James E. Smith

Presented by Dan Amelang

How does the DIVA Checker keep up?



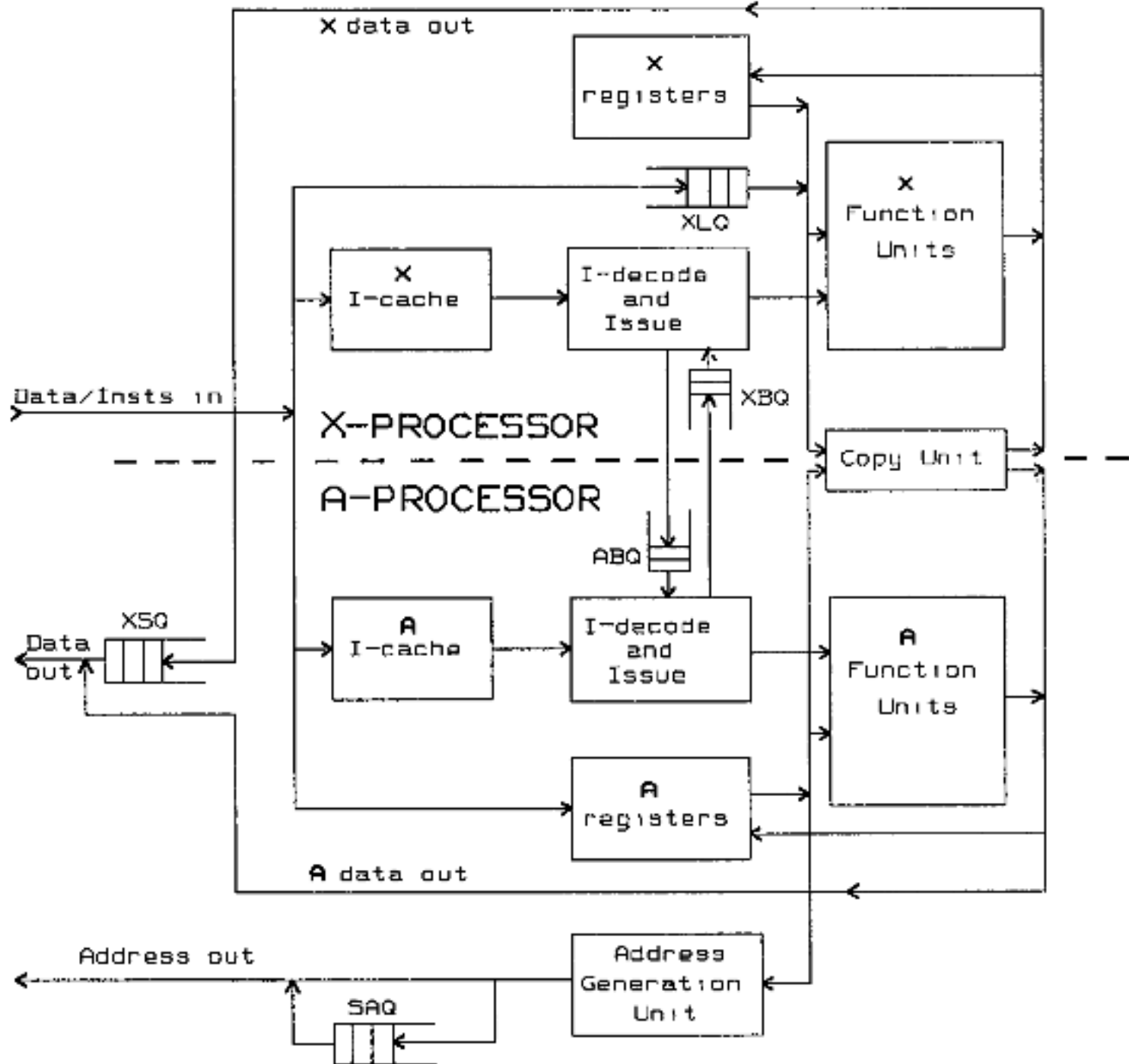
Decoupled Access/Execute (DEA)

- Goals
 - Increase ILP
 - Increase issue bandwidth
 - Hide memory latency

DEA

- Two cooperative, co-dependent processors
 - Access processor
 - address generation
 - memory requests
 - Integer ops (sometimes)
 - Execute processor
 - Floating point
 - Complex integer ops (sometimes)

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DEA vs. CRAY-1

Table I. Performance Simulation Results for the 14 Lawrence Livermore Loops

Loop	CRAY-1	Decoupled	Speedup
1	41	20	2.1
2	60	32	1.9
3	26	14	1.9
*4	38	20	1.9
*5	62	48	1.3
*6	64	47	1.4
7	81	56	1.4
*8	200	118	1.7
9	96	58	1.7
10	101	63	1.6
*11	27	21	1.3
12	27	17	1.6
*13	146	135	1.1
*14	149	126	1.2
Average			<u>1.58</u>

Advantages

- Higher issue bandwidth w/out complexity of superscalar
- Increased ILP w/out complexity of OOp
- Can sometime handle memory latency better than a cache
- Decoupled architecture is more modular

Disadvantages

- Compiler must generate two instruction streams (even if they end up interleaved), avoid deadlock
- Access processor needs to stay ahead of the Execute processor
- Provides a more limited form of ILP than OOp
- Initially, people thought architecture queues were a bad idea

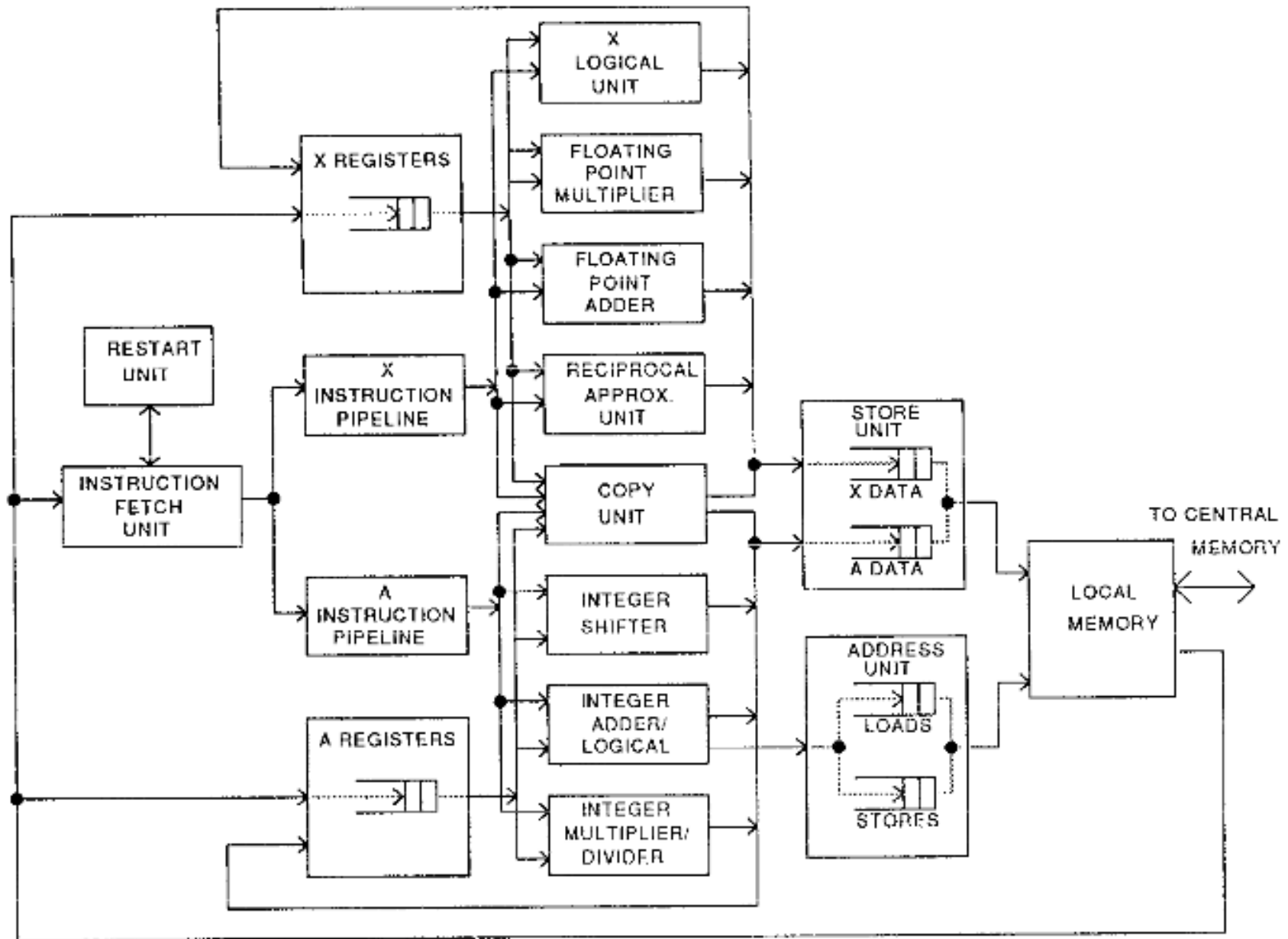
OOe vs. DEA

- Register renaming
- Instructions can execute ahead of previously blocked instructions
- Execute instructions block waiting on memory
- Architecture Queues
- Instructions local to processor execute in order, but out of order with respect to the other processor
- Execute instructions rarely wait on memory

Instantiations of DEA

- MAP-200
- Astronautics ZS-1 (James Smith)
- WM
- PIPE
- Several half-hearted adoptions

ZS-1



DEA Research

- Even DEAs need data caches, see “Memory Latency Effects in Decoupled Architectures”
- SMT and DEA mix well, see “The Synergy of Multithreading and Access/Execute Decoupling”

DEA Research

- We can decouple control too, see “The Effectiveness of Decoupling”
- We can decouple all over, see “Instruction Level Distributed Processing”