HETEROGENEOUS SYSTEM COHERENCE
for Integrated CPU-GPU Systems

Jason Power*, Arkaprava Basu*, Junli Gu†, Sooraj Puthoor†,
Bradford M Beckmann†, Mark D Hill*†, Steven K Reinhardt†, David A Wood*†

*University of Wisconsin-Madison  †Advanced Micro Devices, Inc.
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CPU-GPU COHERENCE

Memory

Directory

CPU

GPU
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4x slowdown

CPU

GPU

Directory

Bottleneck

Memory
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Bottleneck

1. More than 2 requests per cycle

4x slowdown
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1. More than 2 requests per cycle
2. Needs more than 10,000 MSHRs

4x slowdown
HETEROGENEOUS SYSTEM COHERENCE

HSC

Memory

Region Directory

CPU

GPU
HETEROGENEOUS SYSTEM COHERENCE

Baseline Directory

Memory

Directory

CPU

GPU

HSC

Memory

Region Directory

CPU

GPU
HETEROGENEOUS SYSTEM COHERENCE

- Speed Up: 3x
- Bandwidth: 1x
- MSHRs: 1x

Memory

Region Directory

CPU

GPU