

# CoNDA: Efficient Cache Coherence Support for Near-Data Accelerators

**Amirali Boroumand**

Saugata Ghose, Minesh Patel, Hasan Hassan,  
Brandon Lucia, Rachata Ausavarungnirun, Kevin Hsieh,  
Nastaran Hajinazar, Krishna Malladi, Hongzhong Zheng,  
Onur Mutlu

**SAFARI**



**Carnegie Mellon**



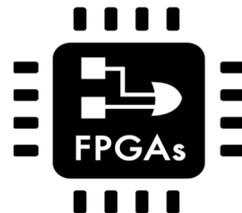
**ETH** zürich

# Specialized Accelerators

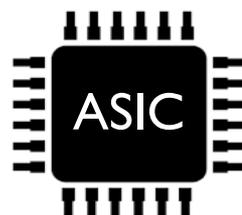
Specialized accelerators are now everywhere!



GPU

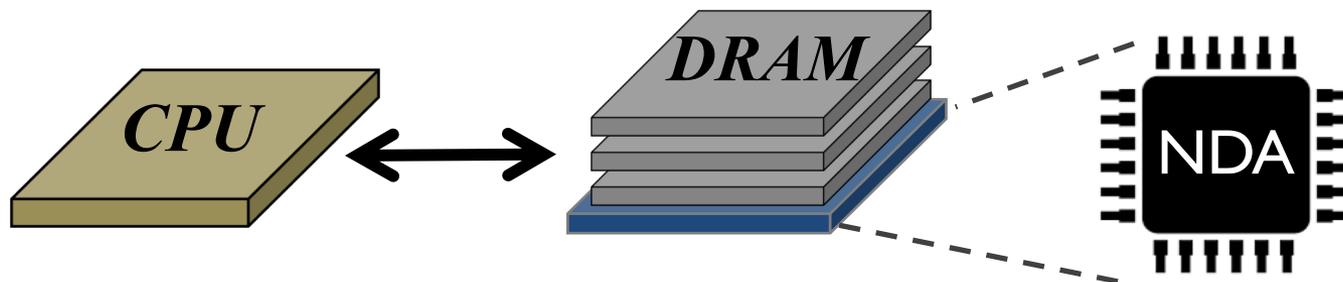


FPGA



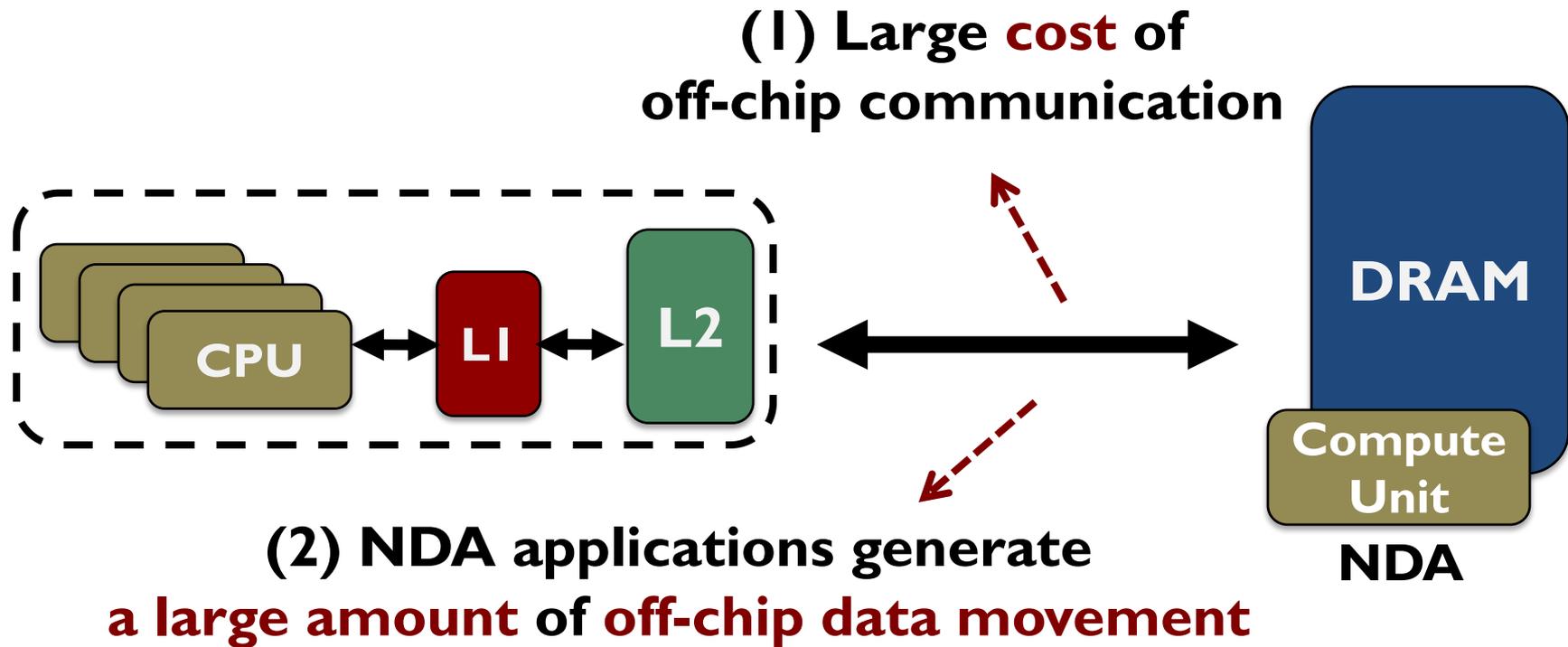
ASIC

Recent advancement in 3D-stacked technology enabled **Near-Data Accelerators (NDA)**



# Coherence For NDAs

## Challenge: Coherence between NDAs and CPUs



It is **impractical** to use traditional coherence protocols

# Existing Coherence Mechanisms

We extensively study existing **NDA coherence mechanisms** and make **three key observations**:

1

These mechanisms **eliminate** a significant portion of **NDA's benefits**

2

The **majority of off-chip coherence traffic** generated by these mechanisms is **unnecessary**

3

Much of the **off-chip traffic** can be eliminated if the coherence mechanism has **insight** into the **memory accesses**

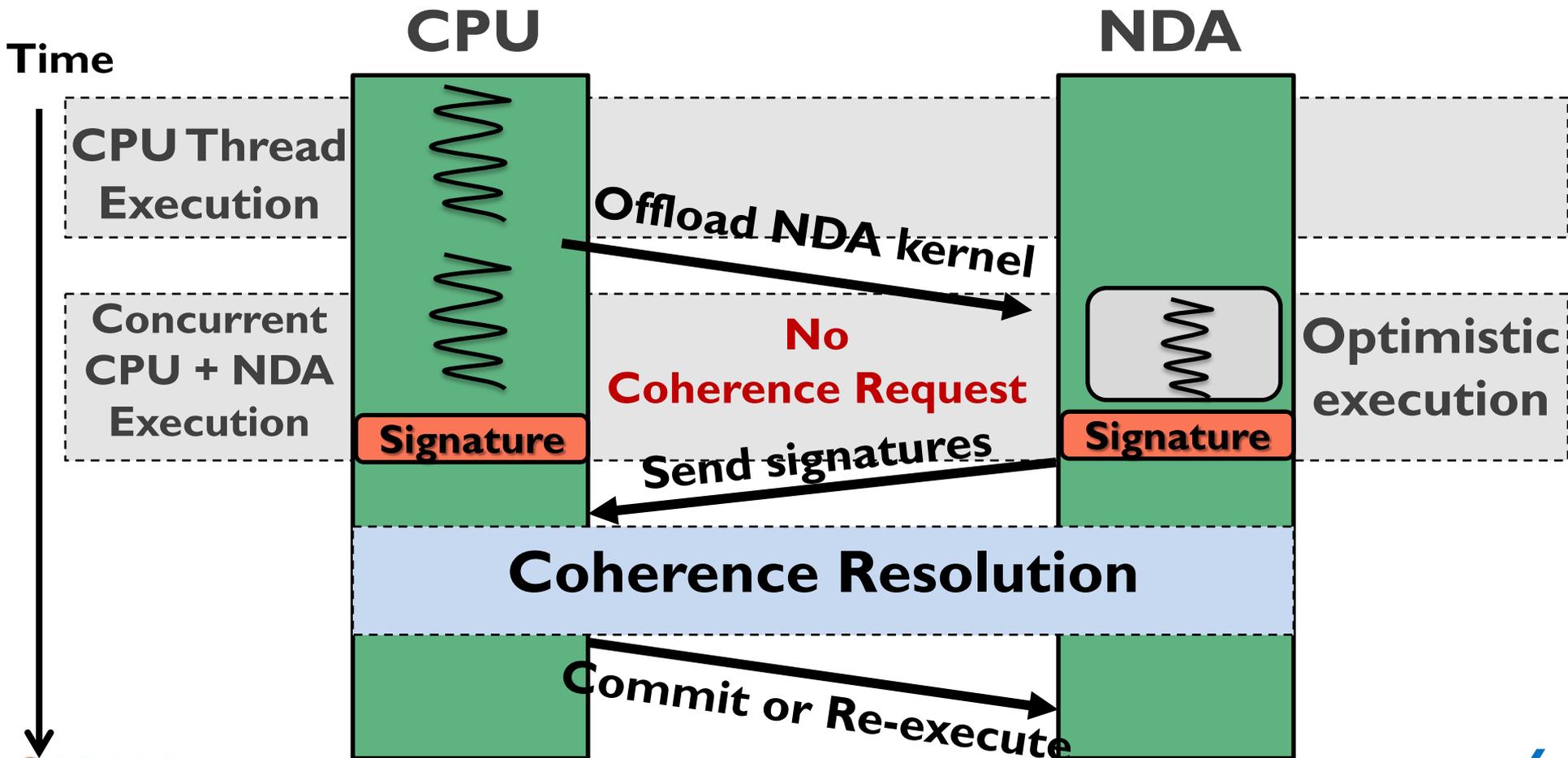
# An Optimistic Approach

We find that an optimistic approach to coherence can address the challenges related to NDA coherence

- 1 Gain insights *before* any coherence checks happens
- 2 Perform *only the necessary* coherence requests

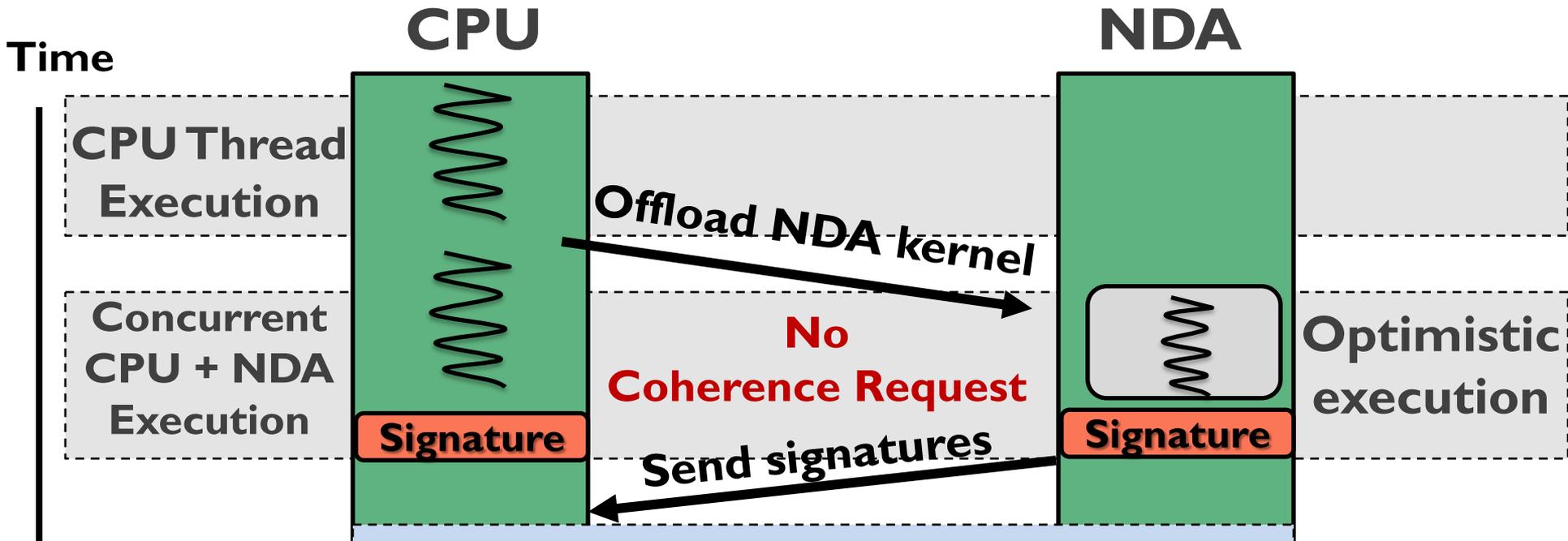
# CoNDA

We propose **CoNDA**, a mechanism that uses **optimistic NDA execution** to avoid **unnecessary coherence traffic**



# CoNDA

We propose **CoNDA**, a mechanism that uses **optimistic NDA execution** to avoid **unnecessary coherence traffic**



CoNDA comes within 10.4% and 4.4% of performance and energy of an ideal NDA coherence mechanism

# CoNDA: Efficient Cache Coherence Support for Near-Data Accelerators

**Amirali Boroumand**

Saugata Ghose, Minesh Patel, Hasan Hassan,  
Brandon Lucia, Rachata Ausavarungnirun, Kevin Hsieh,  
Nastaran Hajinazar, Krishna Malladi, Hongzhong Zheng,  
Onur Mutlu

**SAFARI**



**Carnegie Mellon**



**ETH** zürich