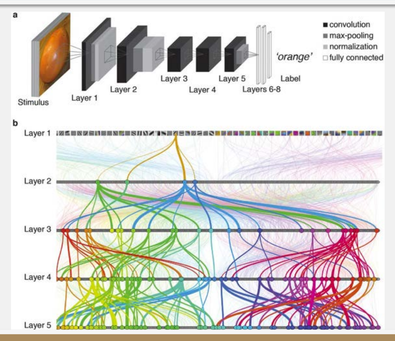
Modular System Design in 2.5D

Zhengya Zhang and Michael Flynn
University of Michigan

3D Heterogeneous Integration: Common Heterogeneous Integration and IP Reuse Strategies (CHIPS)

Machine Learning Systems

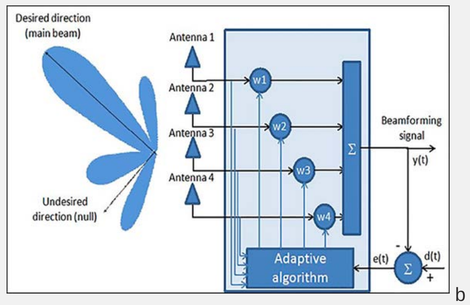
- Large-scale compute
- Large memory capacity
- High access bandwidth



a

Smart Antenna Systems

- Mixed-signal
- Heterogeneous integration
- High-bandwidth streaming

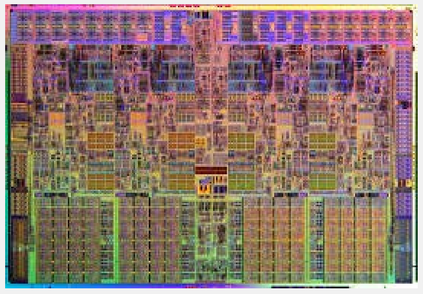


b

Current Approaches

Monolithic Integration

- Soft IP reuse
- High design effort, high risk
- Cost prohibitive



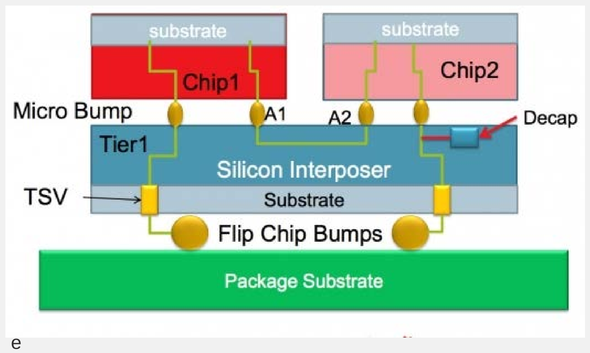
c

Board-Level Integration

- Hard IP reuse
- Heterogeneous integration
- Low performance

d

New Approach: 2.5D Integration



e

Benefits:

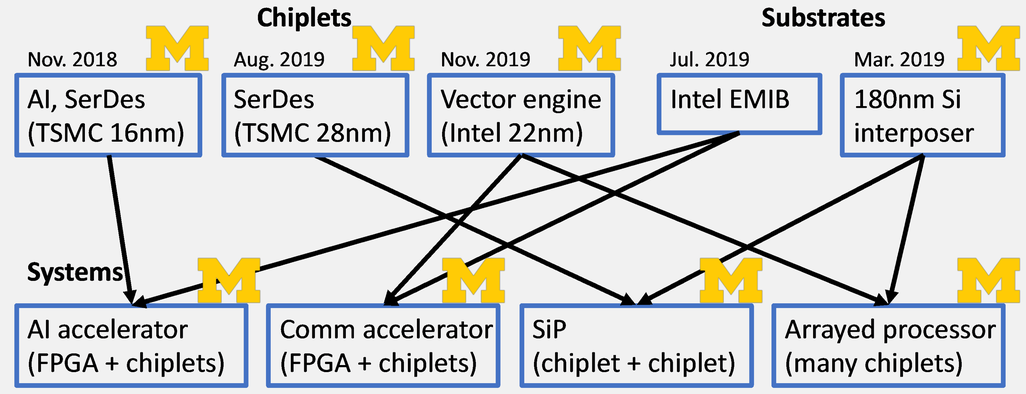
- Hard IP reuse
- Lower effort, risk, & cost

Challenges:

- Standard interface
- High-speed IO
- Availability of IPs

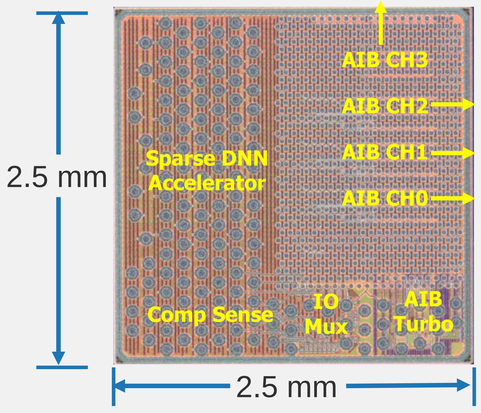
Image Credits:
a: Nature https://www.nature.com/articles/srep27750/figures/1
b: PLOS http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0140529
c: Intel https://www.intel.com/pressroom/archive/releases/2008/20081117comp_sm.htm
d: Electronic Notes https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/pcb-design-layout-guidelines.php
e: Silicon Semiconductor https://siliconsemiconductor.net/article/78947-Silicon-interposers-has-the-market-arrived.php

Heterogeneous Chiplets, Flexible Integration

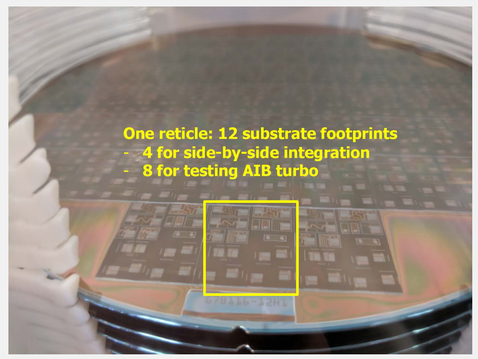


Chiplet and Substrate Prototype Design

16 nm CMOS AIB Test Chip with Micro and Core Bumps

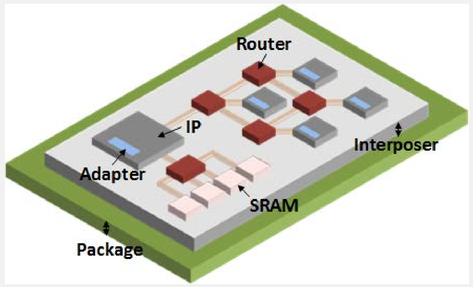


180 nm Passive Silicon Interposers



200mm CMOS wafers

Phase 1 Demo Systems



A large-scale AI system composed in 2.5D using chiplets

Potential Impacts

- IP reuse: >80%
- Heterogeneous integration
- NRE reduction: >70%
- Time reduction: >70%
- Performance: >100%

This research was developed with funding from the Defense Advanced Research Projects Agency (DARPA). The views, opinions and/or findings expressed are those of the author and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.

THE ELECTRONICS RESURGENCE INITIATIVE