Smart Semiconductor Systems for Agriculture and Environment

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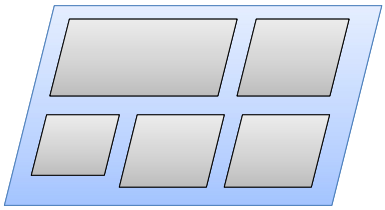
IN OUR GRIT, OUR GLORY

Low-cost chiplet systems

Chiplets have been very successful in servers, desktops, laptops.
How do we leverage chiplets for low-cost systems?
Goals:

- Substantially lower cost.
- Systems with sensing, computation, memory and storage, communication.



The case for chiplet IoT de vices

Huge market for IoT devices. Devices must be low cost.

Chiplets should encourage mix-and-match systems to deliver variety at low cost.

IoT needs heterogeneous technologies: MEMS, analog, digital, memory, storage, RF.

IoT may operate at lower clock speeds, allowing for less aggressive technologies.

The case against chiplet IoT systems

IoT substrate systems may not be achievable at sufficiently low cost.

Some chiplets may not be cost-effective: flash, DRAM.

Poor substrates may induce increased power consumption.

Environmental ruggedness may not be sufficiently high.

Wireless performance and power consumption may be a limiting factor.

Low performance + high error rate means low payload ratio.

Application analysis

Sensor sample rate, bandwidth requirement.

Analysis data rate, coefficient rate.

Communication.

Ag/environment use cases

Sensing for crops:

- Moisture, chemicals.

Sensing for animals:

- Temperature, moisture.

Image analysis:

- Plants, animals.

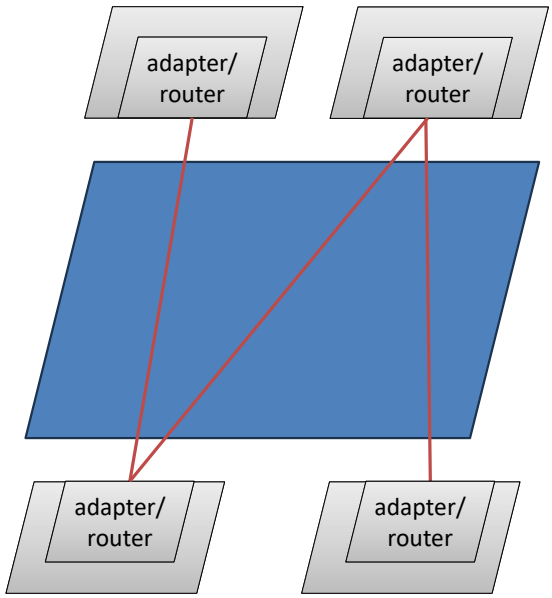
IoT chiplet + substrate architecture

Design alternatives:

- Interconnect only, interconnect plus transistors.
- Substrates:
  - Silicon.
  - Flexible electronics substrate.

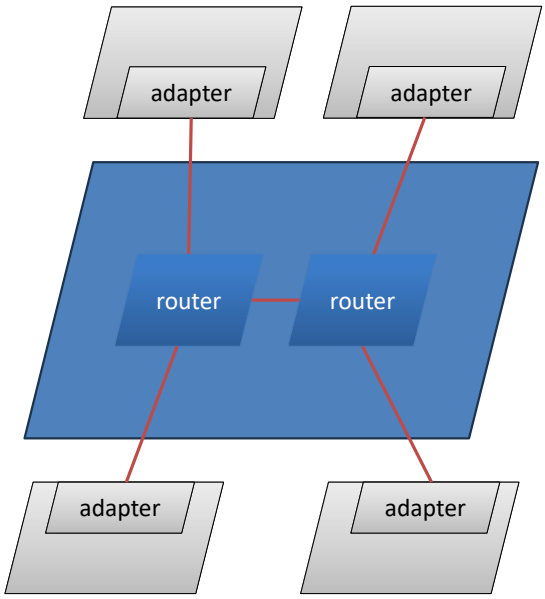
Chiplet NoC,

Passive substrate with hub-and-spoke architecture.



Chiplet NoC, cont'd

Active substrate with mesh architecture.



Architectural alternatives

Separate compute and memory, mid-range NoC.

Integrated compute and memory, low-range NoC.

NoC *vs* bus, does NoC have any advantage? Not much application parallelism to exploit.

Is NoC lower power than bus? Shorter links have lower capacitance.

Summary

Agricultural and environment provide huge new markets for semiconductors.

Sensor systems must meet a wide range of requirements.

System requirements can be traded-off against each other.

New packaging provides opportunities, presents challenges.