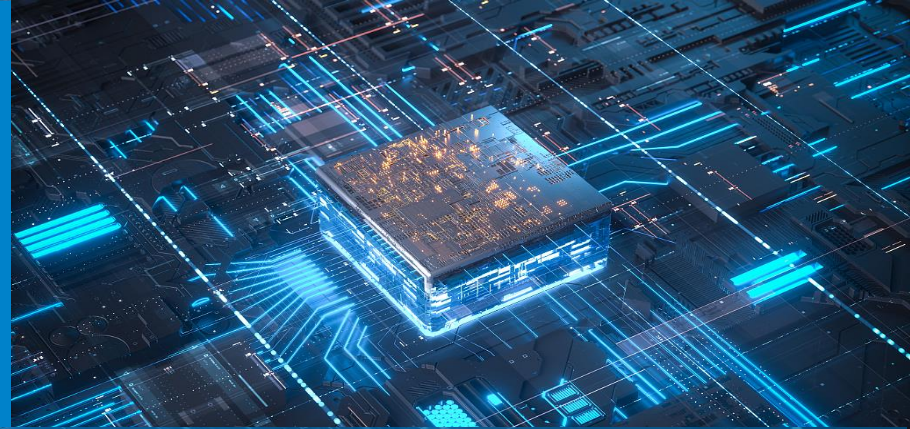
DATE 05/24/2023

ROLE OF HETEROGENEOUS INTEGRATION FOR ENERGY EFFICIENCY



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FUTURE OF COMPUTING

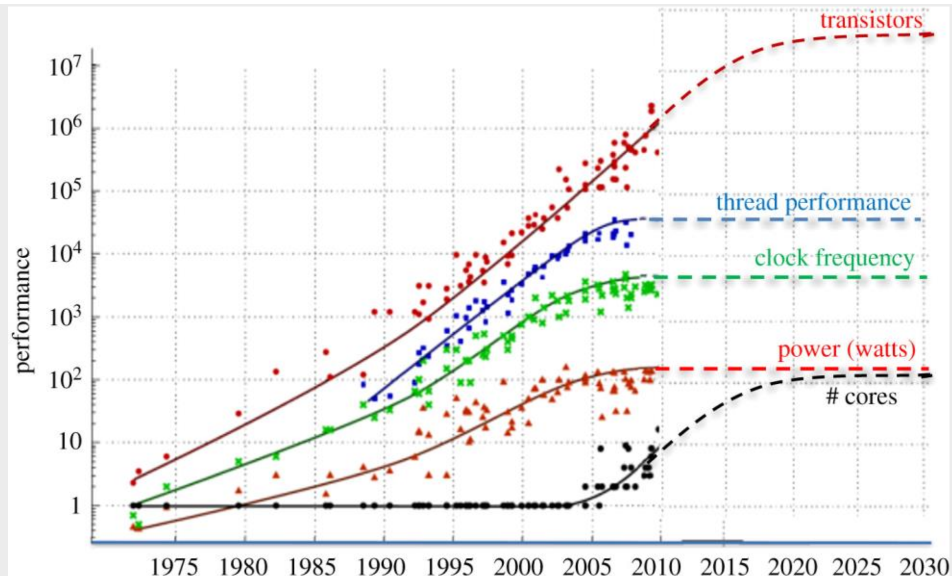
More Moore

Challenges:

- End of Dennard Scaling

  Scaling transistors down improves speed and reduces energy consumption

- Heat removal issues- clock-based scaling
- Focus: more power efficient and less expensive to build

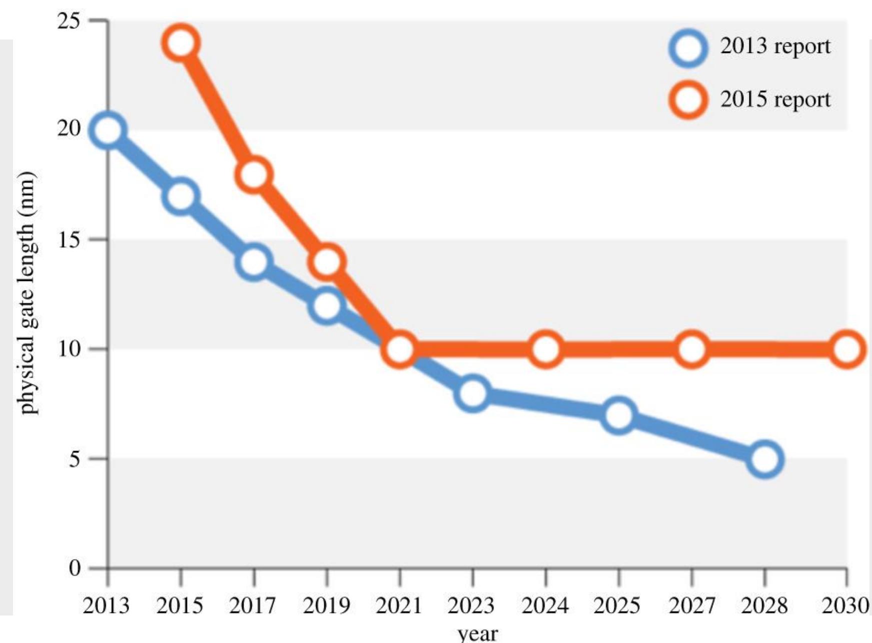


https://doi.org/10.1098/rsta.2019.0061

FUTURE OF COMPUTING

More Moore

- End of lithographic scaling
- ITRS report predicts transistor scaling will end in 2021



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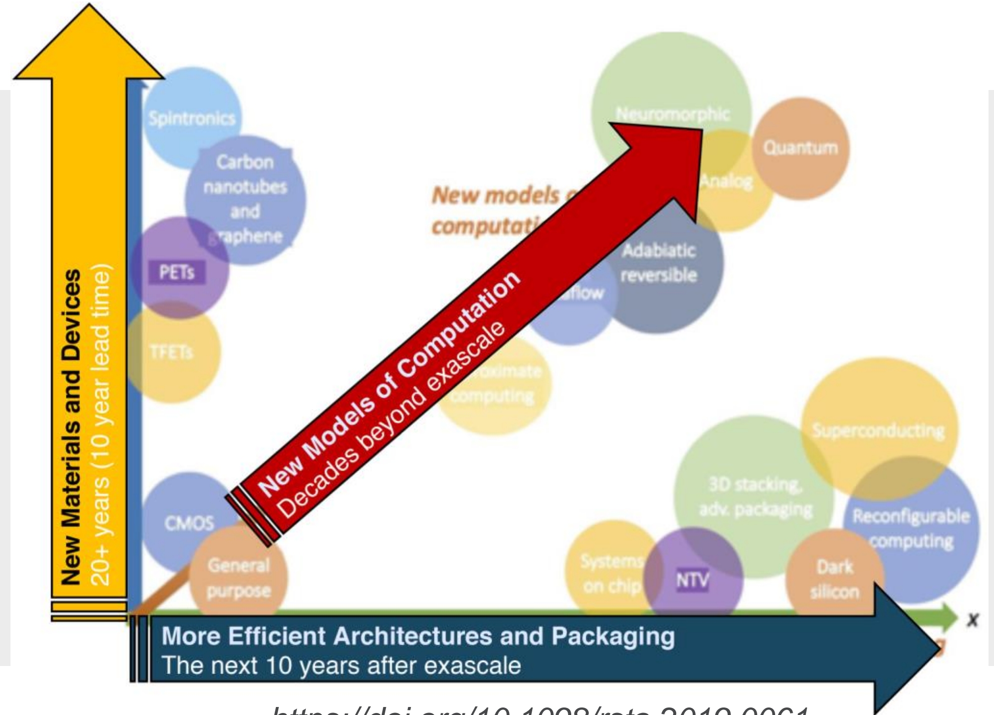
FUTURE OF COMPUTING

More than Moore

- Integrating functionalities at system level

  More functions lower system cost

- *Adding analog, RF, MEMS, HV circutir, control and passive components*



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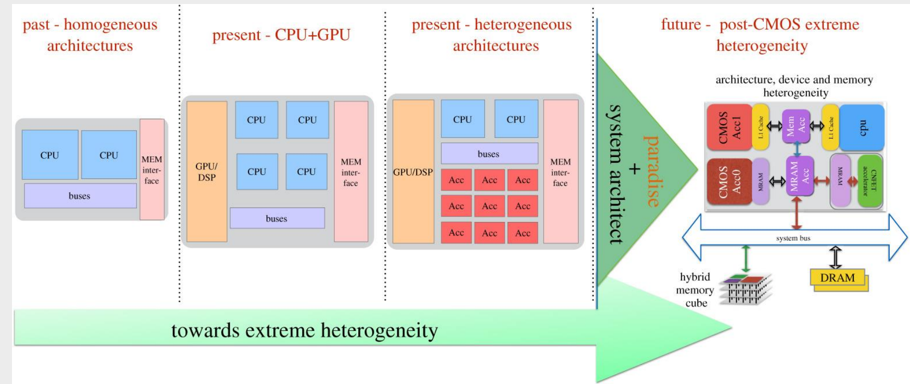
HETEROGENEOUS INTEGRATION

More than Moore and Beyond's Moore

- Near-term response: architectural specialization and extreme heterogeneity
- Provide additional value to end application



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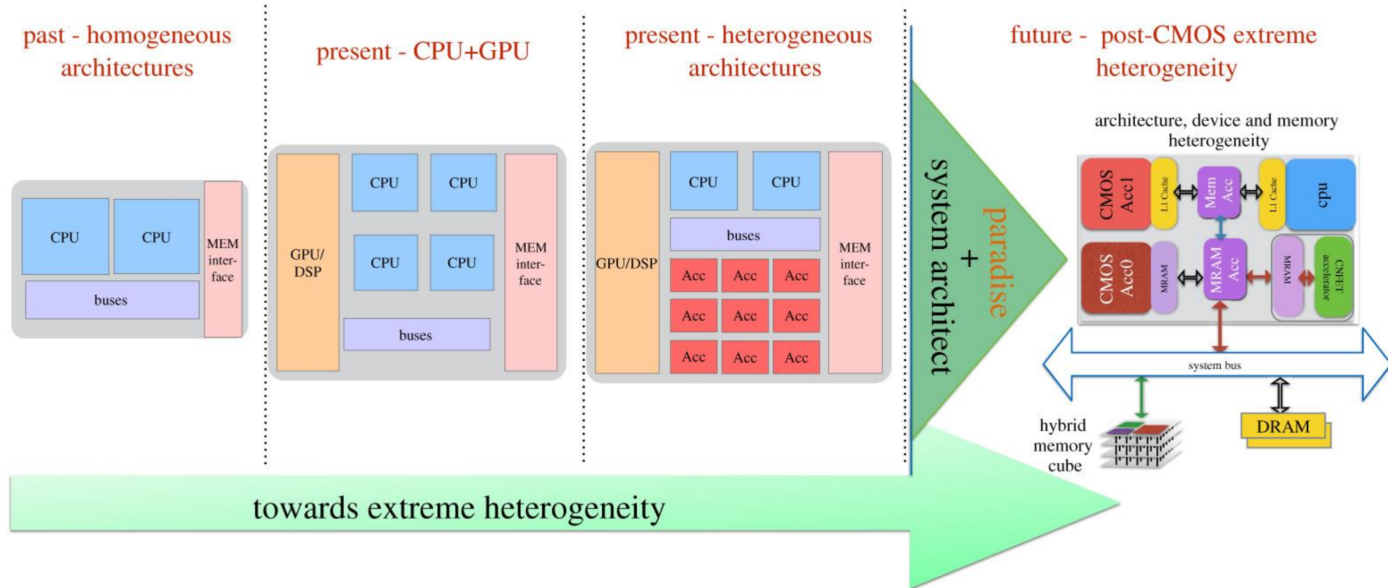
HETEROGENEOUS INTEGRATION

More than Moore and Beyond's Moore

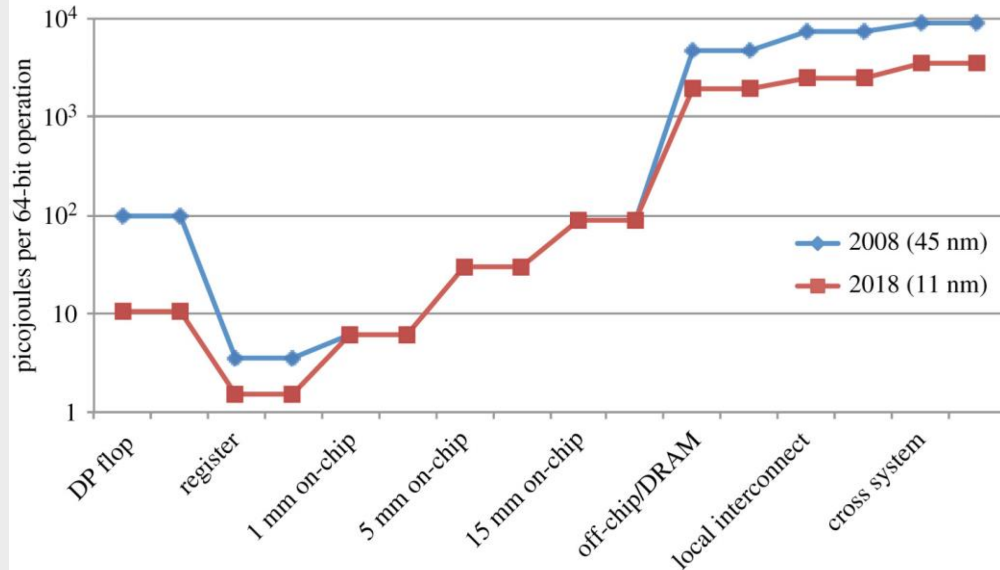


HETEROGENEOUS INTEGRATION

Beyond’s Moore- Challenges ahead

- Energy efficiency of transistors is improving as sizes shrink
- Energy efficiency of wires is not improving

We have come to a point where the energy needed to move data exceeds the energy used to perform the operation on those data



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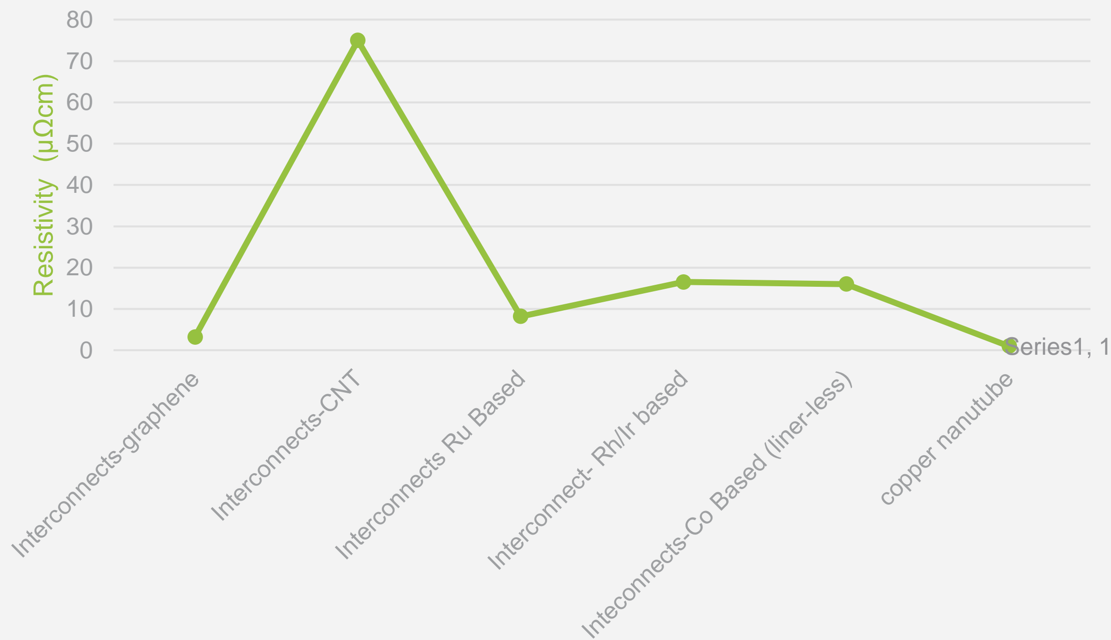
HETEROGENEOUS INTEGRATION

What's next?

- Advancing interconnect
- Advancing packaging, thermal interface etc

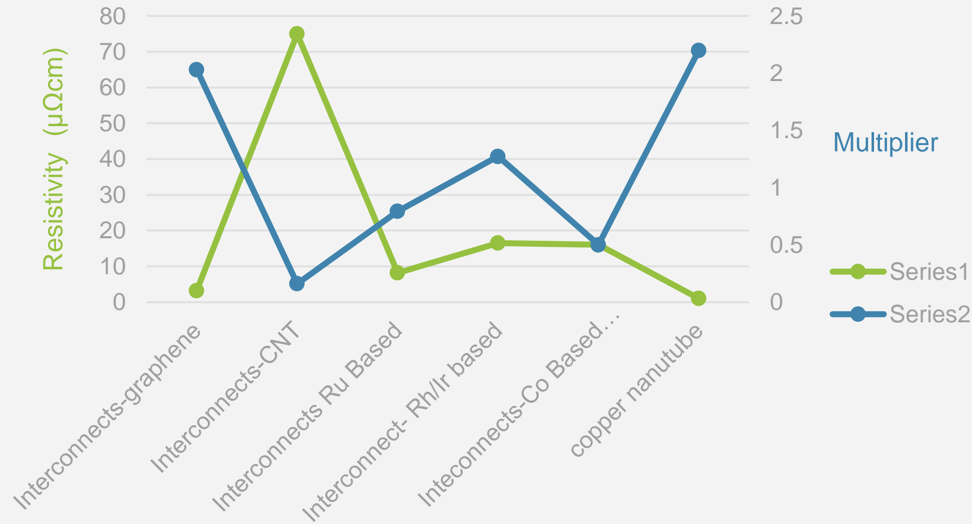
HETEROGENEOUS INTEGRATION

Advancing interconnect –replacing Cu



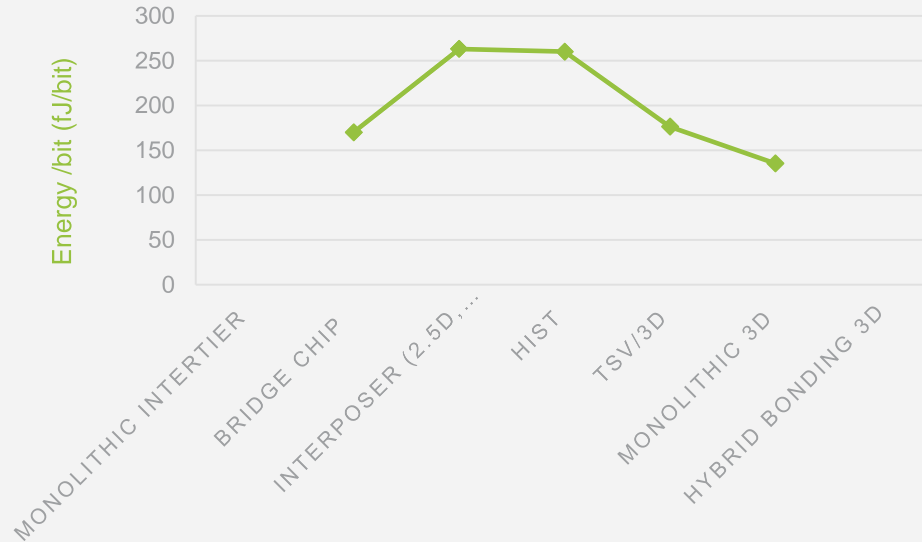
HETEROGENEOUS INTEGRATION

Advancing interconnect –replacing Cu



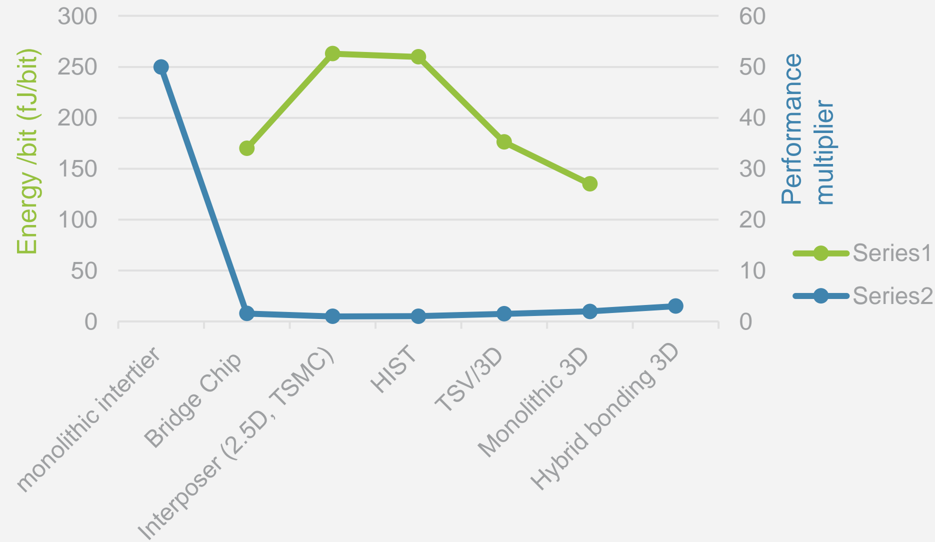
HETEROGENEOUS INTEGRATION

Interconnects-for enabling chip stacking



HETEROGENEOUS INTEGRATION

Interconnects-for enabling chip stacking



THANK YOU

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