



WIPLASH

Towards internet of everything: THz wireless networks for next generation compute platforms

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WWRF Workshop: THz waves – Fast lane journey to 6G

April 22, 2021



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**UNIVERSITÄT
SIEGEN**

Higher
Throughput

Higher
Efficiency

What will 6G be?

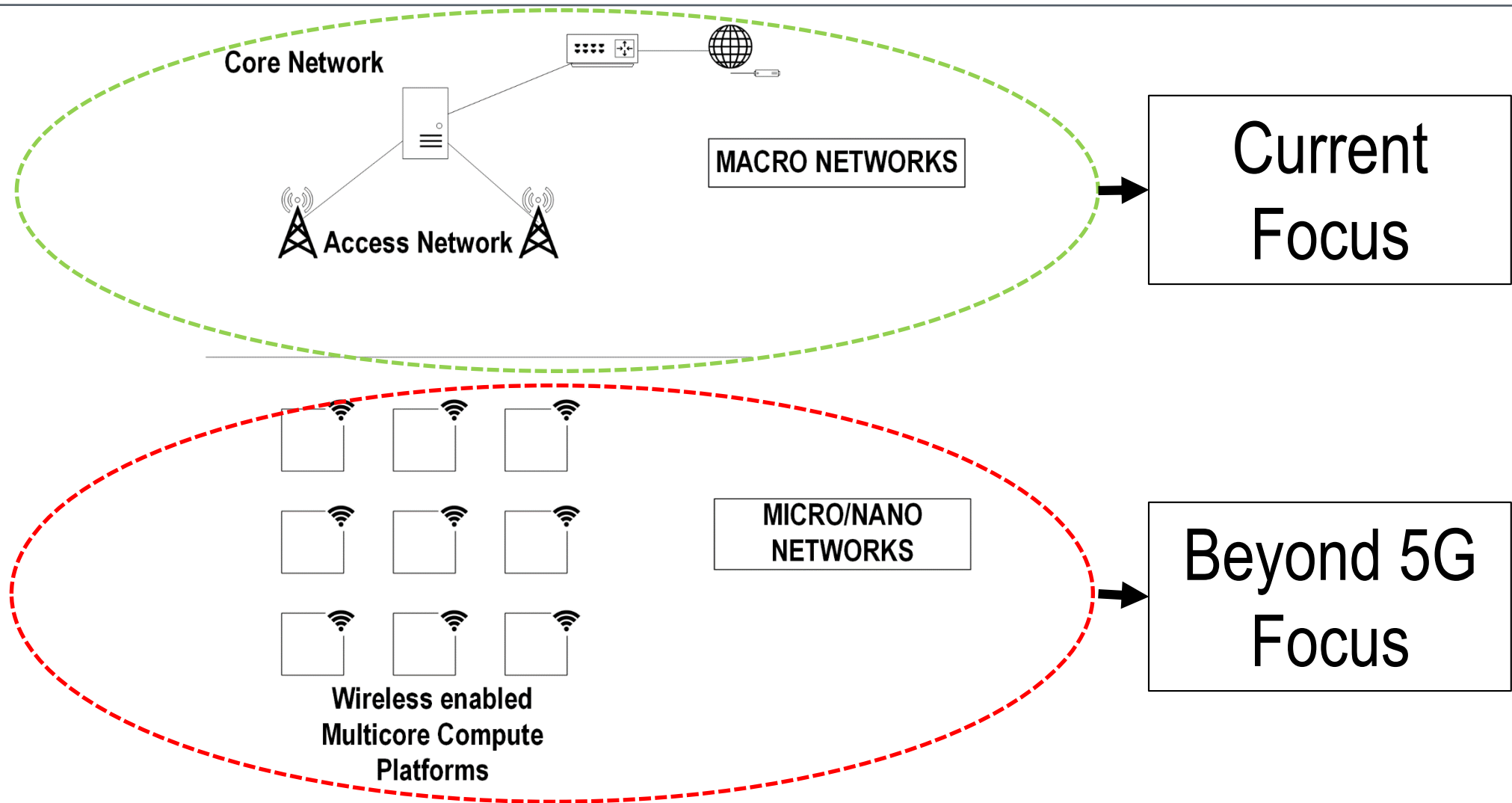
Lower
Latency

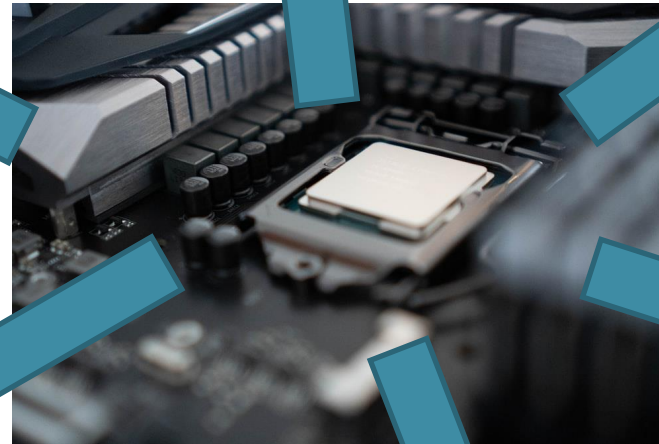
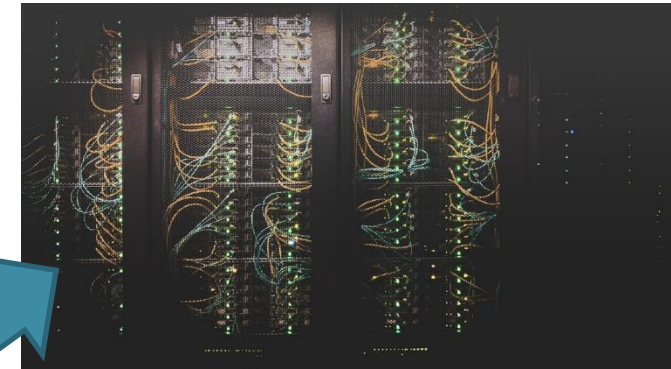
Higher
Throughput

**CONNECTIVITY
EVERYWHERE**

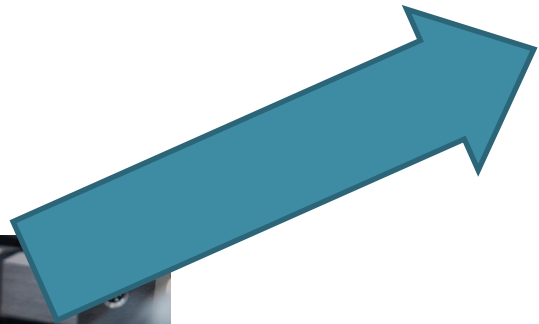
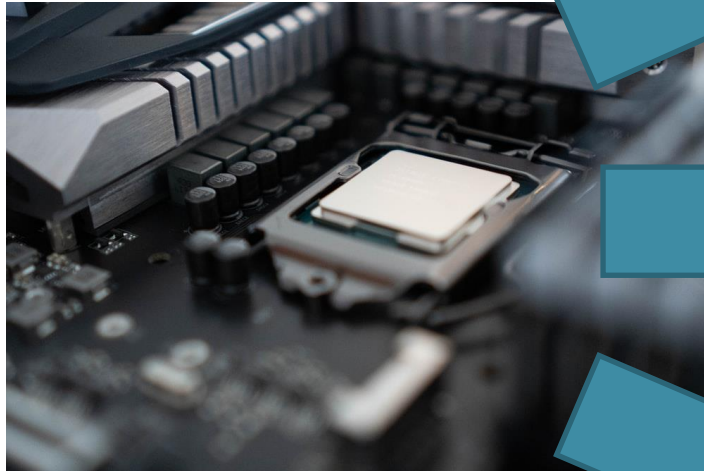
Higher
Efficiency

Latency





The problem



We want them faster



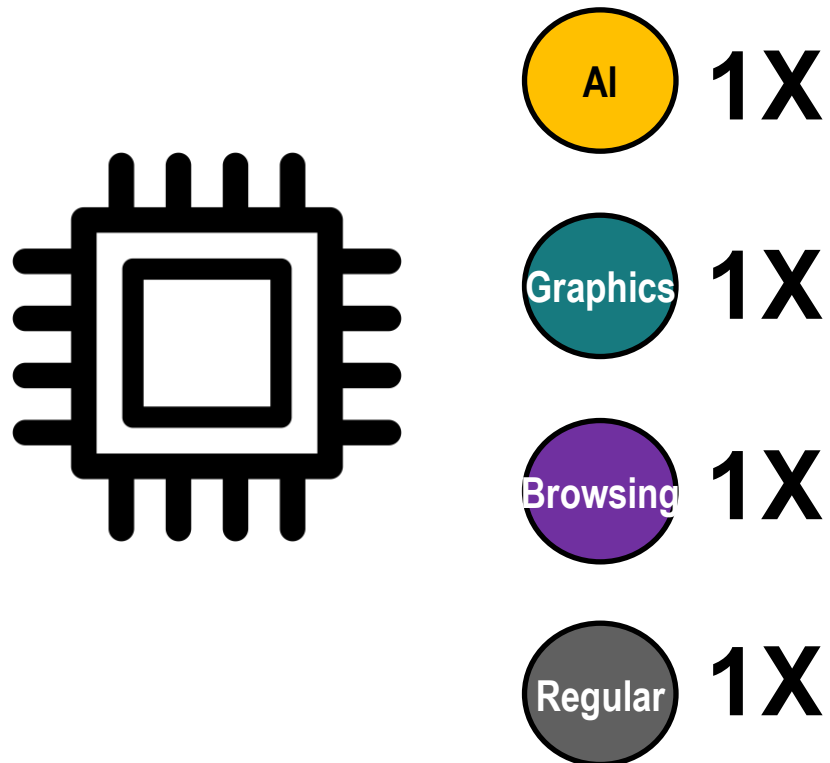
We want them more efficient



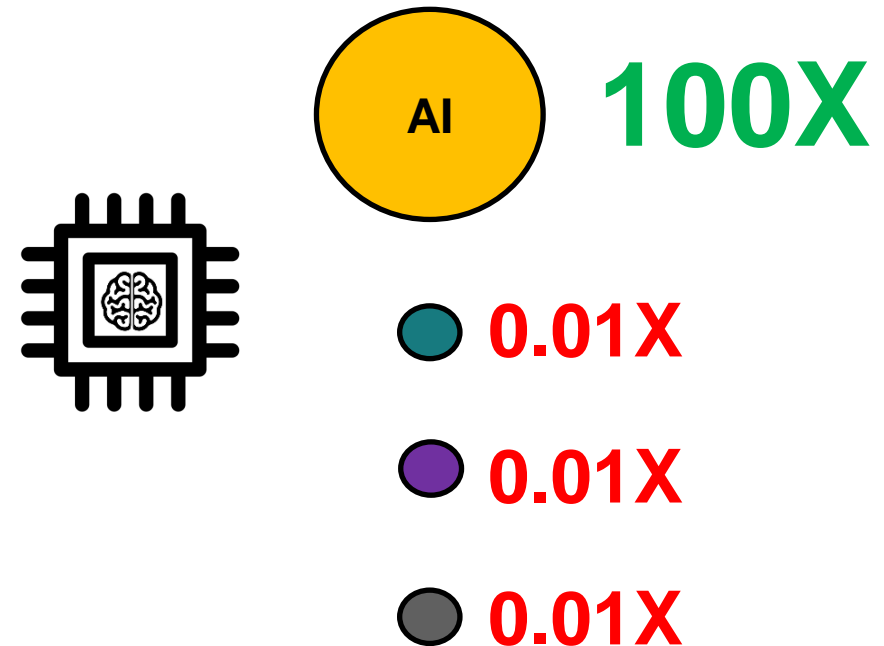
Anywhere, always

How are processors designed

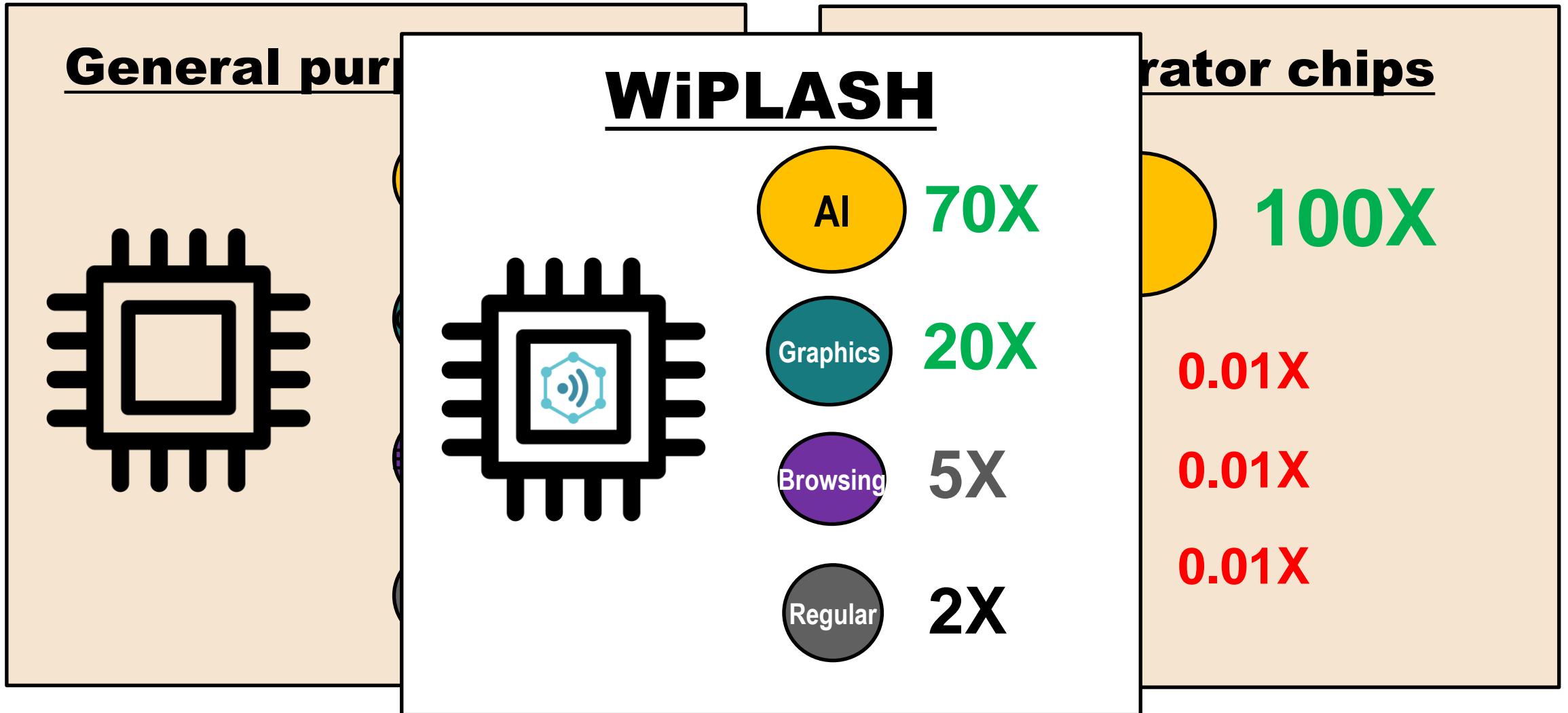
General purpose chips



Accelerator chips



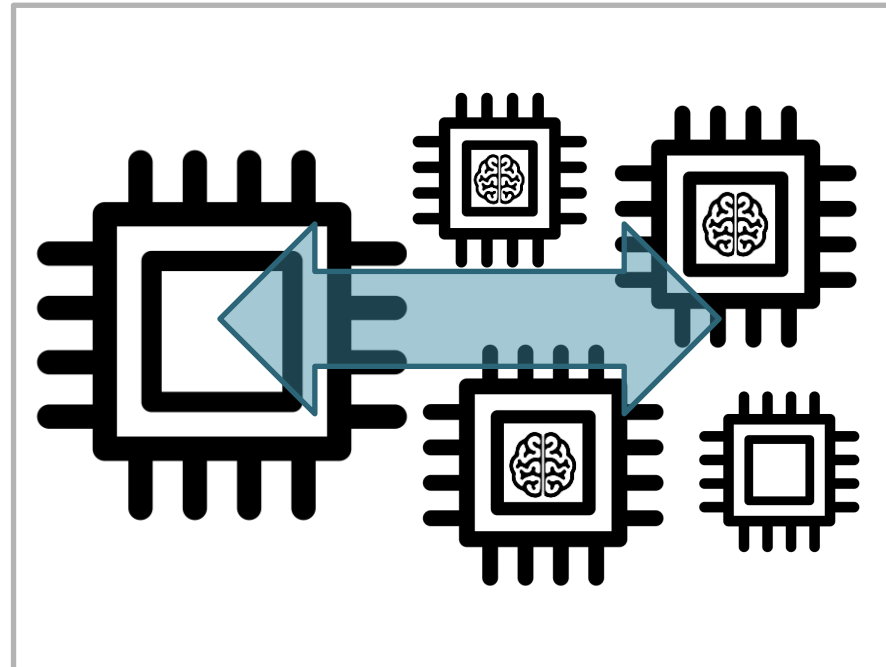
The WiPLASH scenario



*The vision of WIPLASH is to create
new processors that are
faster
more efficient
all the time*

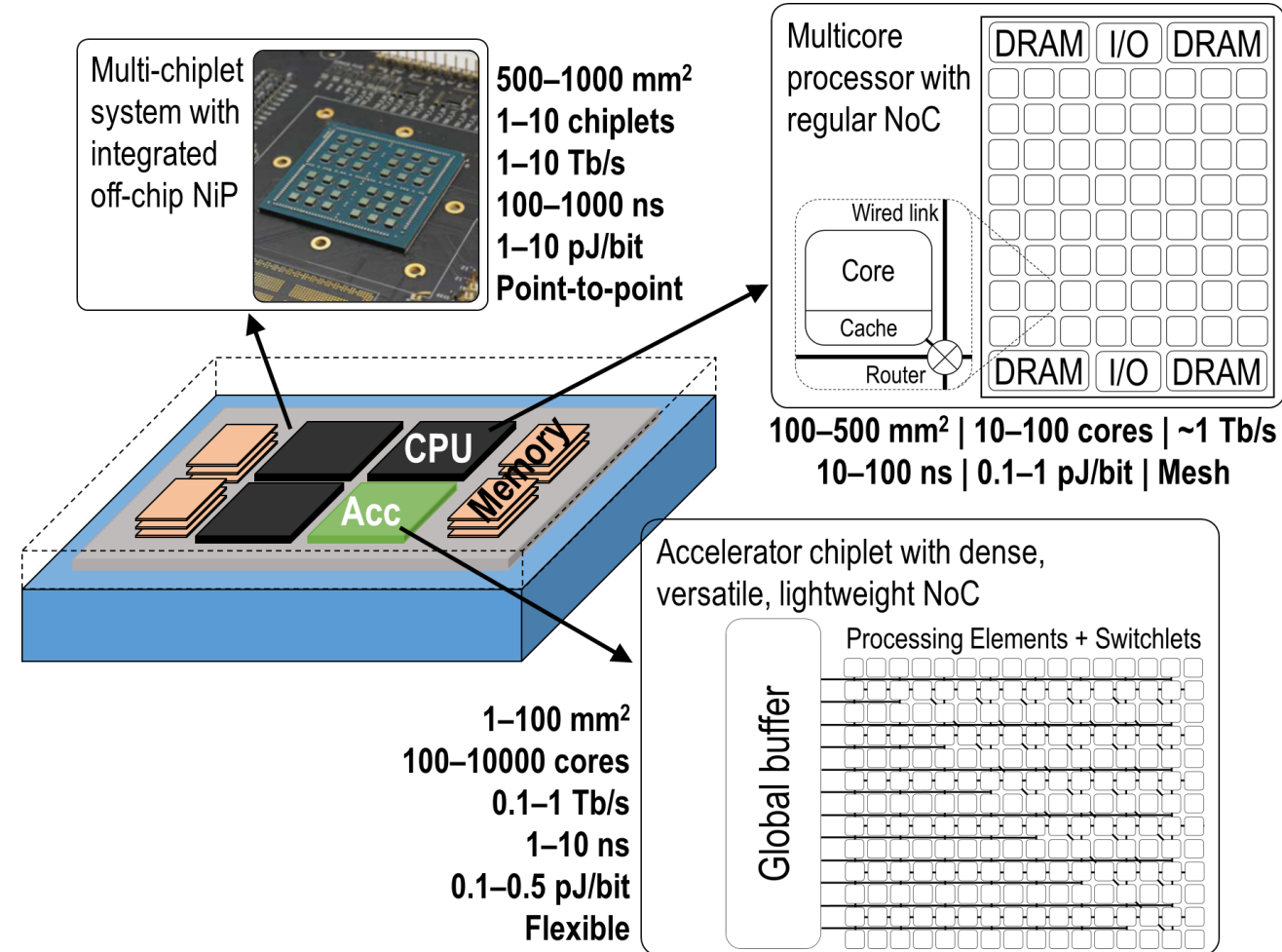
How?

Wireless communication is the key



Why wireless?

- The interconnect is at the center of heterogeneous systems. Communications are challenging:
 - Intense
 - System-dependent
 - Uneven (spatially)
 - Dynamic (temporally)



Why wireless?

- The interconnect is at the center of the system architecture
-
-
-
- Dynamic (temporarily)

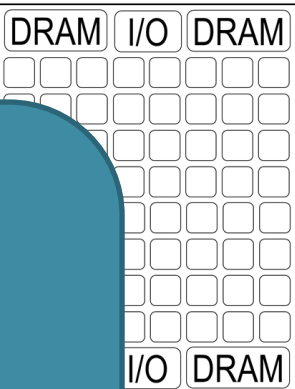
If communications are delayed, the processor has to slow down!

Multi-chiplet system with



500–1000 mm²

Multicore processor with

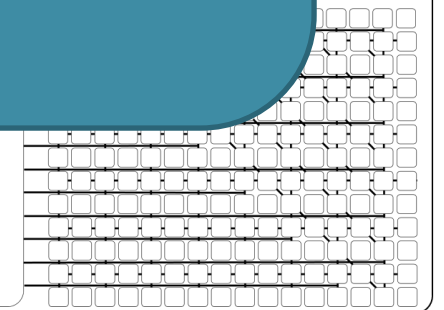


cores | ~1 Tb/s
bit | Mesh

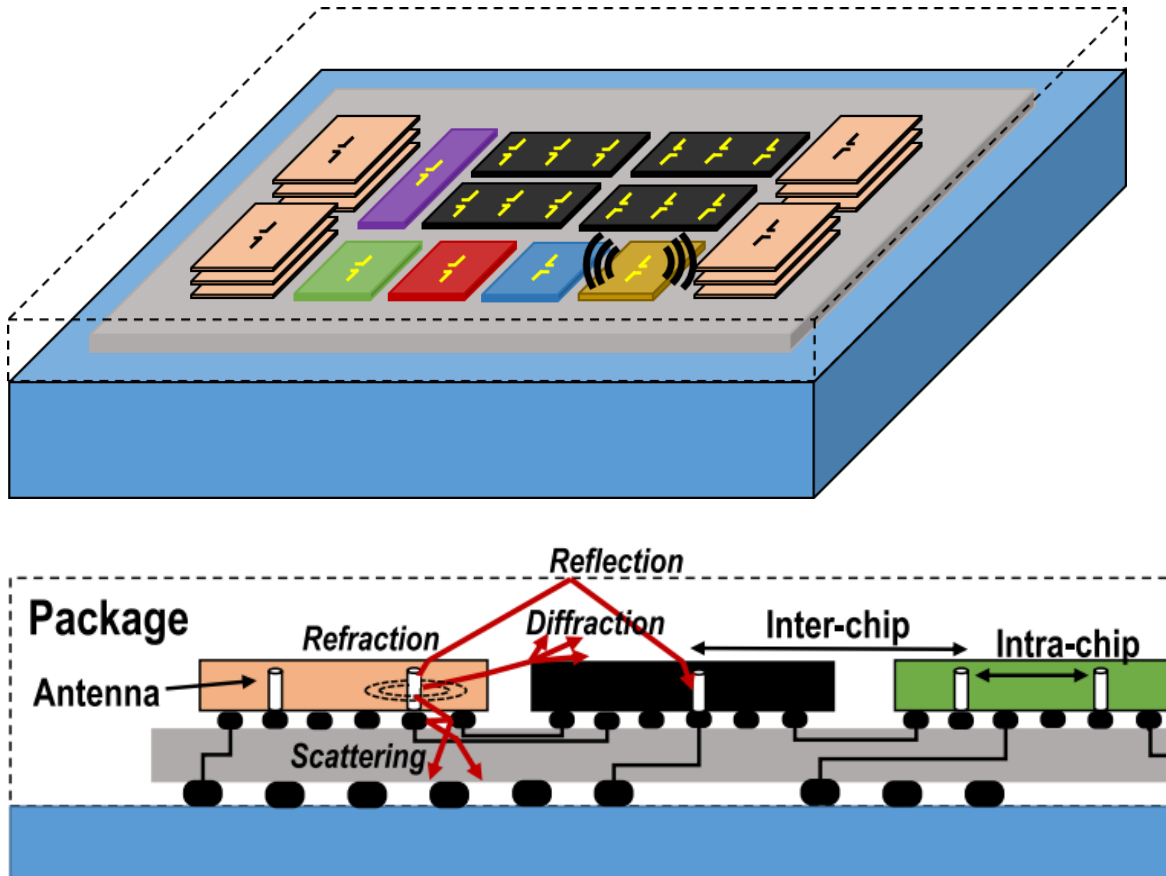
0.1–1 Tb/s
1–10 ns
0.1–0.5 pJ/bit
Flexible

Global

Switchlets

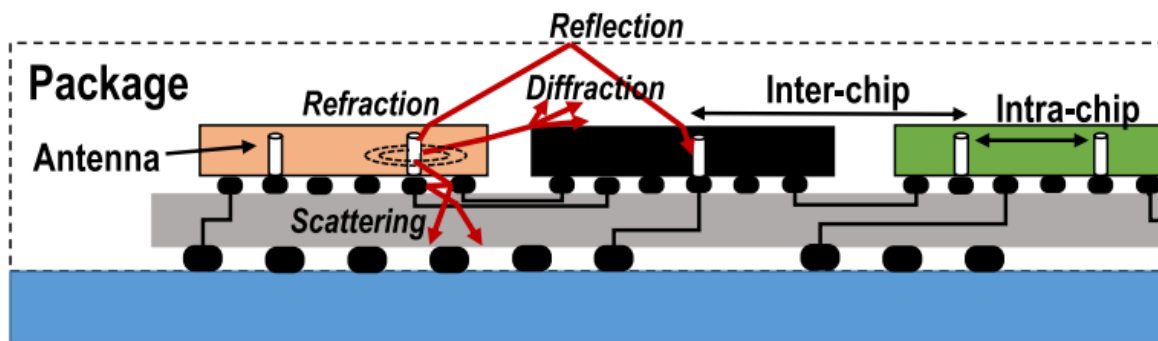
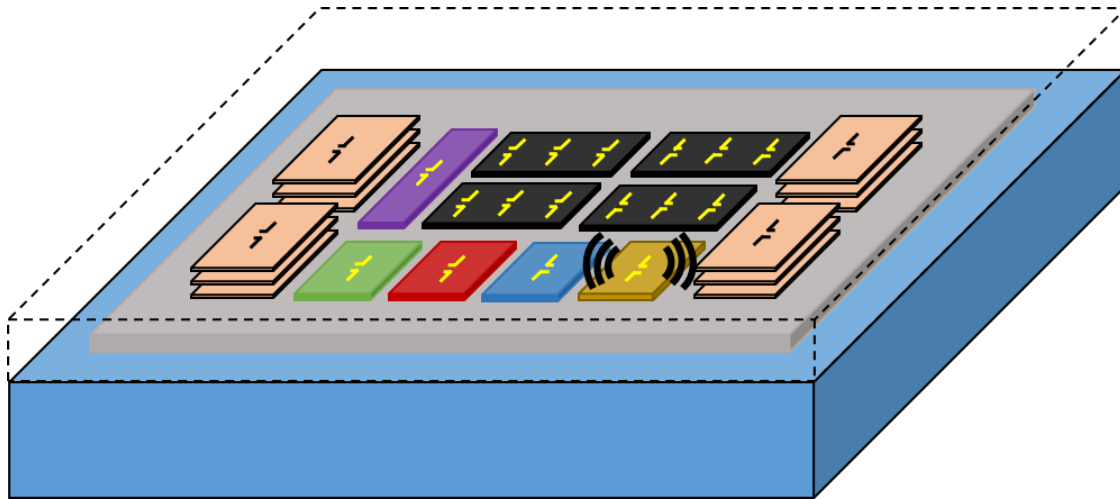


The WiPLASH approach



- Integrate on-chip antennas into chiplets.
- Wireless networks through the processor package.
- Complements a wired network.

The WiPLASH approach: Advantages



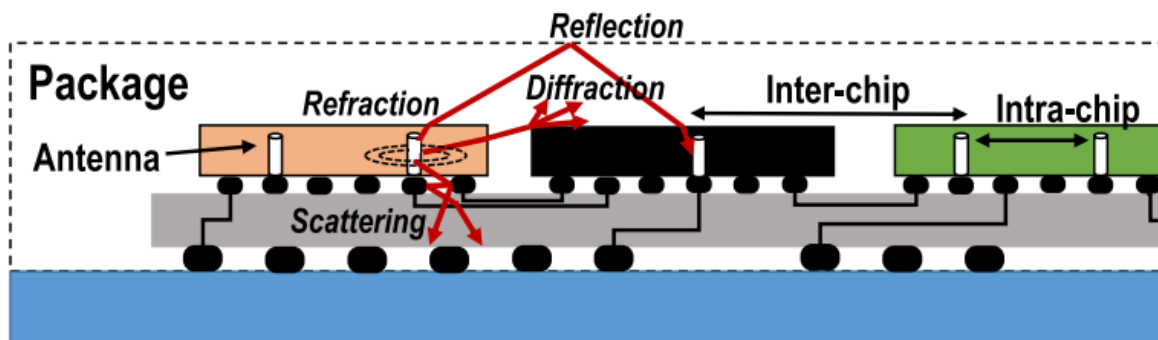
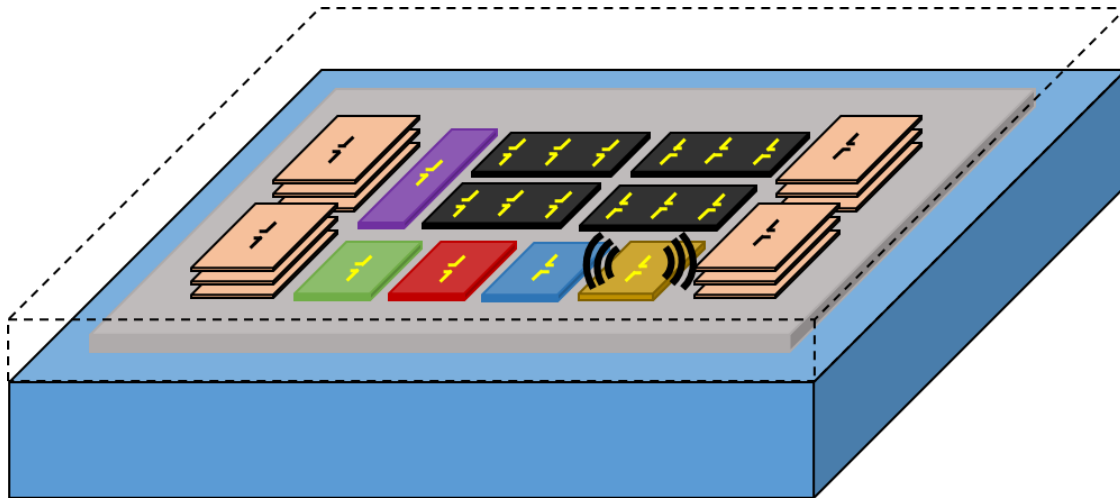
Low Latency (chip-wide, ns)

Flexibility

Broadcast and Multicast capabilities at lower costs

Static environment and quasi-deterministic traffic: ~ optimal design

The WiPLASH approach: Challenges



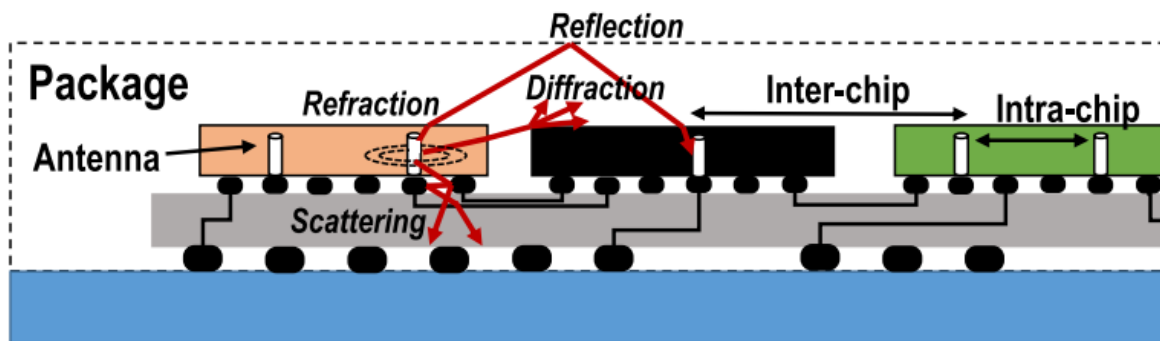
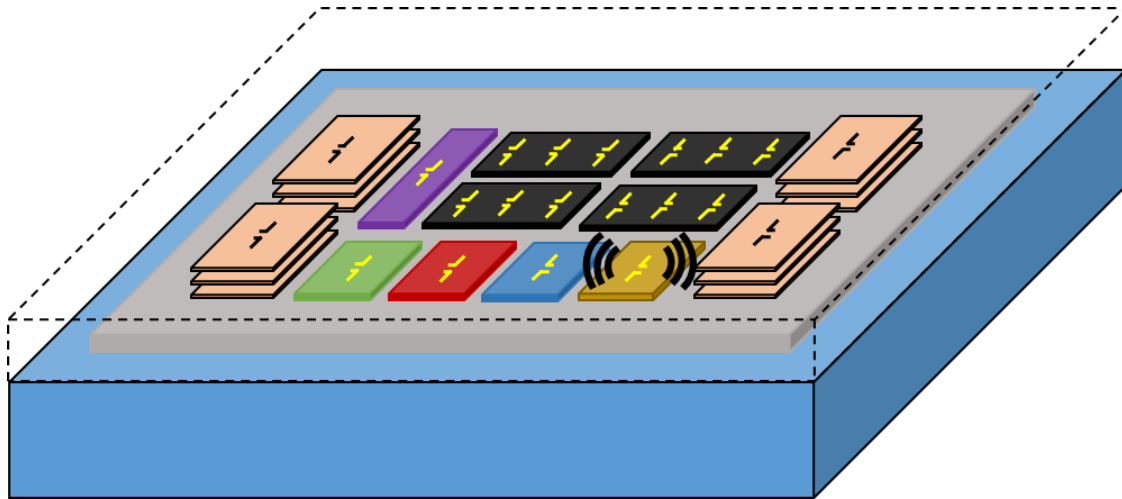
Significant power
(~pJ/bit) and area (~mm²)
constraints

Heterogeneous and
hotspot natured traffic
characteristics

Extreme Reliability (BER
< 10⁻¹²)

Low Algorithmic complexity

The WiPLASH approach: How do we do it?



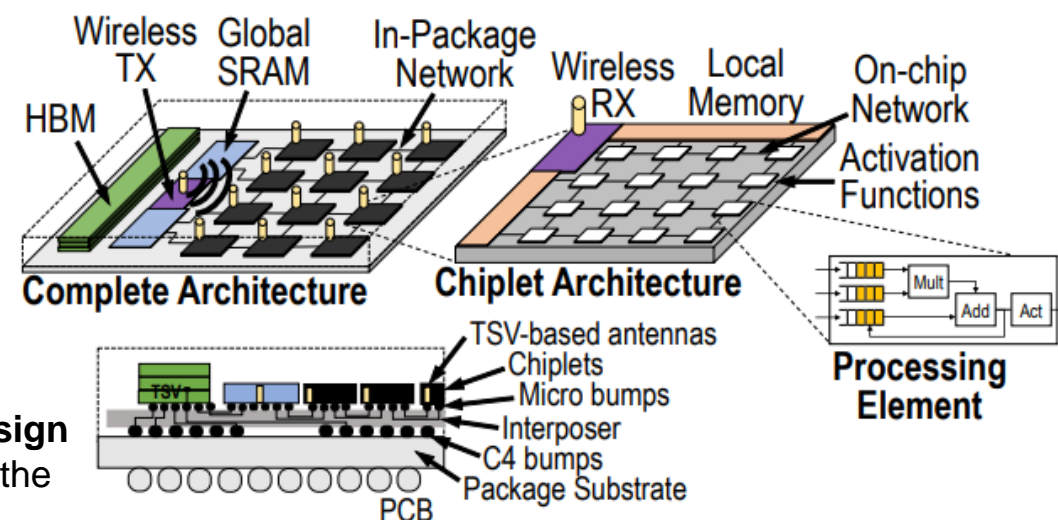
THz wireless: small antennas, high throughput and lower latency

Graphene Antennas: Miniaturization and tunability in the THz band

Smart-MAC: Low complexity medium access methods for extreme reliability and adaptiveness

Arch-NDO: Network design optimization, utilizing the quasi-deterministic nature as well as accounting for architectural limitations

- Can we scale-out DNN accelerators thanks to wireless interconnects? WIENNA
 - One TX in memory, one RX in each chiplet
 - Plasticity enables adaptive data flows
 - Wireless bandwidth of 64 Gb/s
 - 2.5X – 4.4X speedups
 - 38% less energy



R. Guirado, H. Kwon, S. Abadal, E. Alarcón, T. Krishna, “**Dataflow-Architecture Co-Design for 2.5D DNN Accelerators using Wireless Network-on-Package,**” in Proceedings of the ASP-DAC '21, Tokyo, Japan, 2021.

Conclusions

- WiPLASH aims to further the push for 5G and beyond networks with the goal of demonstrating the feasibility of "wireless in everything".
- Heterogeneous architectures benefit from wireless, through its low latency, system-level flexibility and inherent broadcast capabilities.
- WiPLASH aims to go one step further thanks to graphene antennas, providing more flexibility and more bandwidth.

Acknowledgments



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Acknowledgments

Find us at

 www.wiplash.eu

 [@Wiplash_eu](https://twitter.com/Wiplash_eu)

 linkedin.com/company/wiplash/

 WiPLASH project

WiPLASH Kick-off meeting,
Barcelona, Oct 2019



WiPLASH 2nd plenary meeting,
Virtual, May 2020



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