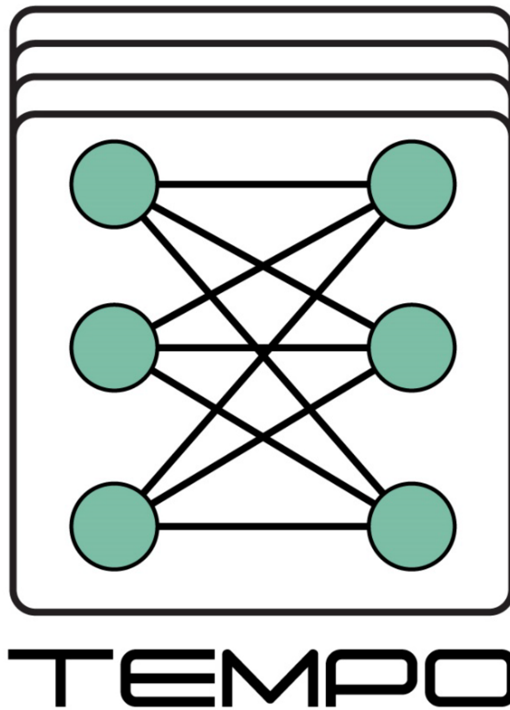
Technology & Hardware for nEuromorphic coMPuting
- ECSEL Research and Innovation Actions (RIA*) –



Deliverable 3.3
Comparative study wafer-to-wafer vs die-to-wafer

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1 Publishable summary

3D partitioning of devices of viewed as being one of the key enablers for pushing device scaling beyond the current apparent wall implied by Moore's Law at sub 3nm device architecture. This partitioning involves splitting System on Chip (SoC) devices at the design stage into different and independently manufactured sub die. The key goal of this approach is to enable Power Performance Area Cost (PPAC) improvements ensuring processing is done at the appropriate technology node for the sub system design.

A key technology enabler for 3D system partitioning is the ability to connect the separate sub parts of the SoC using bonding techniques. Traditionally this has been done at die level using uBumps as interconnects, leading to a trade off between performance of interconnect, interconnect pitch density and tool capability to attach different die together whilst still maintaining good alignment between the die.

Enablement of fine pitch interconnect partitioning is coming through hybrid bonding, which in turn can be separated into Wafer to Wafer (W2W) and Die to Wafer (D2W). Each approach has advantages and disadvantages. W2W enables finer pitch interconnects (sub 1um has been shown at state of the art), but comes with the disadvantage of more expensive bonding tools, impact on Known Good Die (KGD) and finally requires die size matching between the wafers. D2W hybrid bonding is significantly behind W2W in terms of process capability enabling ~5um pitch interconnects at state of the art. The bonders are less costly, however the integration flows are significantly more complex. The key advantage of this approach is KGD enablement, plus the ability to stack non-area matched die.

Both approaches have essentially the same challenges. Those challenges are explained at high level in the following report, with a summary table comparing the IMEC opinion of pros vs cons contained within the conclusion section.