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The Demonstrators of the APECS Pilot Line

High Performance Computing – Multi Material Sensor – Optical Transmitter – Radio Frequency Solutions

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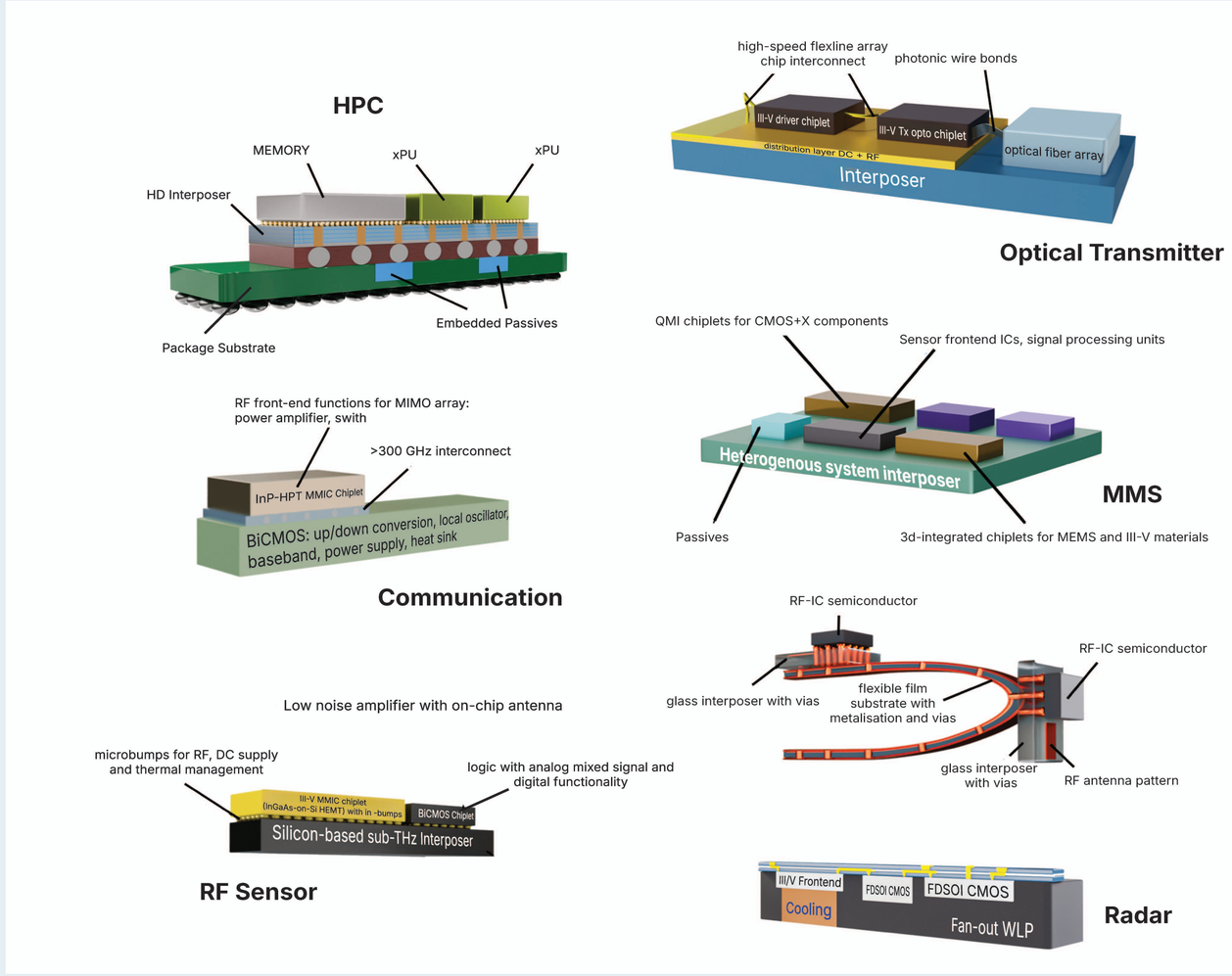
During the start-up of the APECS Pilot Line, four application areas of advanced heterogeneous integration are addressed by the realization of demonstrators that highlight and evaluate the combined capabilities of the pan-European project partners: High Performance Computing (HPC), Multi Material Sensor (MMS), Optical Transmitter, and Radio Frequency Solutions. The chosen APECS demonstrators validate the pilot line operation by utilization of the conceived decentralized design and process capabilities (STCO). In particular the logistical and technological interfaces between different cleanrooms of varying requirements and the efforts needed to enable designers to use the different technologies. The aim is not only to optimize the transfer between processing steps, but also to enable process combinations that expand the capabilities of chiplet technologies and hetero integration alike while maintaining efficiency close to a centralized process environment. The resulting demonstrators were chosen to address most current challenges in microelectronics and yield chiplets ready for integration or chiplet modules.



High Performance Computing (HPC)

Two functional and several non-functional HPC demonstrators will set examples of a more versatile heterogenous integration than it is currently available to address key challenges in the European electronics market. One functional demonstrator implements a high performance computing unit for data center, the other an ultra low power mixed-signal AI chiplet module for mobile AI based systems with RF interface.
There will be the manufacturing of ultra-high-density redistribution layers and through silicon vias. Also, resistors and capacitors will be embedded into silicon interposers. The work package will furthermore improve assembly on advanced organic substrate.
Within the APECS pilot line development the HPC demonstrator will not only show the capability of the line itself but also the advantages of System-Technology-Co-Optimization (STCO). A customized set of PDKs and ADKs will be generated, used and evaluated.
The demonstrators will also help to find a common language between the worlds of system and technology to provide the technology to a wider audience.

Multi-Material Sensor (MMS)

This demonstrator addresses the packaging and integration of multi-material sensor components, ranging from CMOS via Post-CMOS to III-V. The sensor interfaces are to be aligned in co-design with their heterogeneous system interposers and sensor frontends. The range of envisaged sensor components covers acoustic, optical as well as gas- and magnetic-sensing chiplets:

- High level of integration including QMI, 2&3D (cost reduction)
- High level of heterogeneous processing
- High level of sensor signal processing to increase the overall system efficiency (neuromorphic accelerator)

Following the requirements and a common STCO approach among all application areas, discrete processing and integration value chains are realized within APECS. The resulting IP portfolio shall offer design flexibility and fast development times for different applications. The MMS contains of the following chiplets: LiDAR (Si-based), hydrogen gas sensor (GaN-based), CMUT (Si-based), and Hall-sensor (GaN- & Si-based). All of the mentioned chiplets will be integrated on one interposer and therewith show the ability of the APECS Pilot Line.

Optical Transmitter for HPC

In this demonstrator an O-Band 4 x 200 G Transmitter with high shore line density for I/O in HPC will be realized. The transmitter comprises a narrow pitch 4 x 200 G InP-based EML array chiplet hybridly integrated with corresponding InP-based EML driver chiplets on an interposer. This interposer carries the electrical feeding lines and the electrical connectors. The fiber coupling of the EML array chiplet will be realized using photonic wirebonds.

Radio Frequency Solutions

In the area of complex, highly integrated RF systems, four different technology demonstrators will be used to show the performance and innovative power of the various combinations of semiconductor and heterogeneous integration technologies. The fields of application that can be addressed from the latest generation of mobile radio applications and wireless links to radar applications. The focus is also on the practical testing of the design enablement developed in APECS (ADKs, tools, etc.) as well as metrological verification and series testing.

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Additional information

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