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Presentation title: Modular 3D mmW and THz Packaging Concepts and Technologies

SHORT ABSTRACT OF PRESENTATION

This talk will start with a short overview of different monolithic microwave integrated circuit (MMIC) technologies for millimeter-wave (mmW) and THz operation followed by the design of MMIC phased array circuits. We will discuss packaging techniques for efficient phased array scaling and demonstrate a 3D modular packaging concept for heterogeneous integration of different MMIC technologies. The 3D modular packaging concept is based on an active transmit array antenna and is scalable in size due to quasi-optical feeding and stackable printed circuit board design. We also show the progress of VTT's wafer-level packaging platform integrating antennas, filters, and active MMIC chips on a single silicon carrier. The technology is based on micromachined waveguides in silicon,

Au-Au wafer bonding, and flip-chip technologies. The process includes only standard fabrication steps that can be automated and allows integration of individual MMICs of different technologies into the same Si module. The process is scalable and cost efficient for future sub-THz and THz communication and sensing applications.

KEYWORDS

Heterogeneous integration, integration, micromachining, phased arrays, terahertz (THz).

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BIOGRAPHY

Mikko Varonen received the M.Sc., Lic.Sc., and D.Sc. (with distinction) degrees in electrical engineering from the Aalto University (formerly, the Helsinki University of Technology), Espoo, Finland, in 2002, 2005, and 2010, respectively.

In 2011, he was a NASA Postdoctoral Program Fellow with the Jet Propulsion Laboratory (JPL), California Institute of Technology (Caltech), Pasadena, CA, USA. In 2012, he was a post-doctoral researcher, and he was the Academy

of Finland Post-Doctoral Researcher with the Department of Micro- and Nanosciences, Aalto University, from 2013 to 2016. During his Post-Doctoral Fellowship, he was a visiting scientist with the JPL, Electrical Engineering Department, Caltech, and the Fraunhofer Institute of Applied Solid-State Physics, Freiburg, Germany. He is currently a Principal Scientist with VTT Technical Research Centre of Finland, Espoo, where he held Academy of Finland Research Fellow post during 2017 to 2022.

His current research interests include the development of RF and mmW-integrated circuits using both silicon and compound semiconductor technologies for applications ranging from astrophysics and earth remote sensing to mmW communications and quantum computing.