

ANNEX A

Collaboration with A*STAR's Institute of Microelectronics (IME)

The 5G mmWave FOWLP Antenna-in-Package is a novel solution based on IME's Fan-Out Wafer Level Packaging (FOWLP) technology, and it has good electrical performance at millimeter wave frequency. This allows the MMIC and antenna to be integrated within the package. Using the 3D FOWLP integration, the antenna in package (AiP) can be designed on top of the MMIC, allowing a scalable sub-array of AiP to be formed. The sub-array AiP is then used to realise the compact antenna array with more elements, to meet the desired beam width, angular steps during beam steering, and radiated power. Such an optimal level of integration is not available in the market currently. This allows for the elimination of a high frequency board to increase cost effectiveness.

Larger antenna arrays assisted by an indigenously designed fine phase shifter enables the concentration of narrower beams of power on the required space, as well as simultaneous beams from base stations at the same frequency spectrum, thus improving spectral efficiency. By integrating the antenna with chips, the losses and the unintended radiation from inter-connects are reduced improving the overall power efficiency and sensitivity by 25 per cent. This improvement will make 5G and satcom systems more environmentally-friendly

Collaboration with A*STAR's Institute for Infocomm Research (I²R)

To maintain a high performance of the system, accurate antenna array calibration is key. The in-situ built-in array fast self-calibration technique from I²R reduces the down-time of communication links by up to ten times. This is achieved through deep learning techniques that process calibration data sets over various operation environments.

These solutions can be applied in 5G cellular infrastructure, drone detection radar, Ka/Ku band SOTM.