# End-to-End D-Band Phased-Array Communication System

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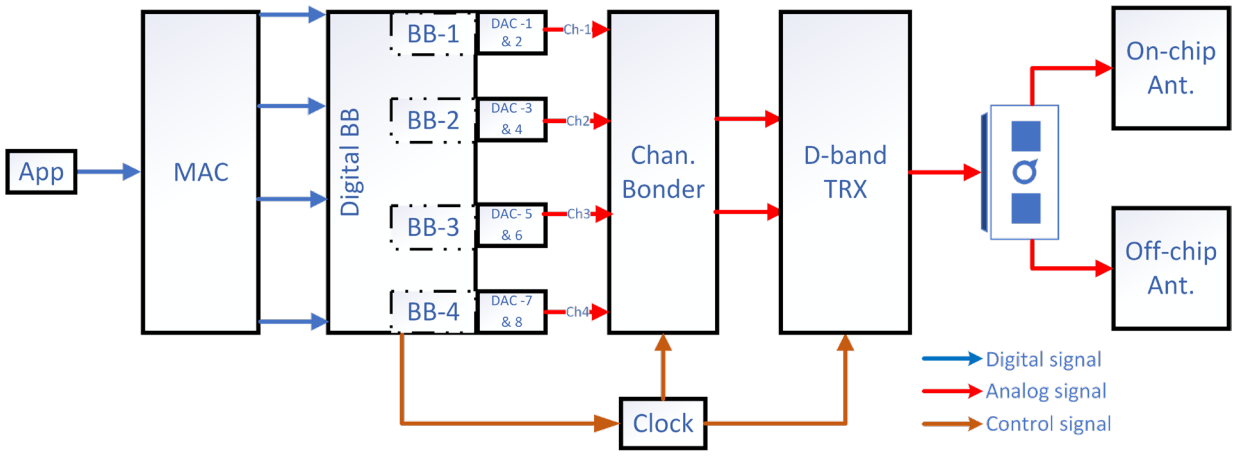
## How could the system adapt to the high bandwidth available at the D-band? How is the processing at Baseband and MAC to support ICAS? Can we have the antenna concept to enable 2-D beamforming?




*The above diagram shows the End-to-End transmitter architecture of the D-band system (receiver architecture is mirrored). This includes MAC, digital baseband, low-speed DACs, analog channel bonder, RF-frontend, and antenna. To facilitate the handling of high bandwidth, we adopt parallel channel processing from MAC to the analog channel bonder. With antenna design, two parallel approaches are followed: on-chip antennas and off-chip antennas. Off-chip antennas are developed with the help of external partners.*

### KEY FINDINGS

There is a need to process the high bandwidth available in the D-band for the ICAS system. The phased array D-band frontend has an RF bandwidth of 60 GHz, translating to 30 GHz in baseband bandwidth. This motivates us to develop a system architecture starting from MAC<-->PHY<--> RF, which can handle these bandwidth requirements. One approach is to parallelize the system from the MAC to the RF front end. This above parallel channel concept handles the baseband signal processing, helps the scalable architecture, and enables ICAS. As each channel is independent of the others. The Chan. Bonder takes these individual baseband channels and combines them with different IF frequencies for each channel which is like analog OFDM. This is fed into the RF front end and transmitted by antennas. Here, we use two parallel approaches for antenna design: (1) the use of on-chip antennas and (2) the use of off-chip antennas where scaling can be performed in 2D, which is an enabler for ICAS.

To summarize, we have a complete system that targets a complete end-to-end system consisting of the following components: (a) We have verified that D-band transceiver RF with an On-chip antenna frontend that could perform beamforming at 1.2 meters and achieve 2 Gbps of data rate, (b) Baseband transceiver operates in SDR mode, and (c) MAC-FEC unit operates with a data rate of 2 Gbps.

A.Karakuzulu, et al. "A Four-Channel Bidirectional D-Band Phased-Array Transceiver for 200 Gb/s 6G Wireless Communications in a 130-nm BiCMOS Technology," in IEEE Journal of Solid-State Circuits, vol. 58, no. 5, pp. 1310-1322, May 2023.

K. Krishnegowda, et al, "Ultra-High Data-Rate Wireless Access & Sensing Demonstrators in D-Band ", Proc. European Conference on Networks and Communications & 6G Summit (EUCNC 2023), (2023)