

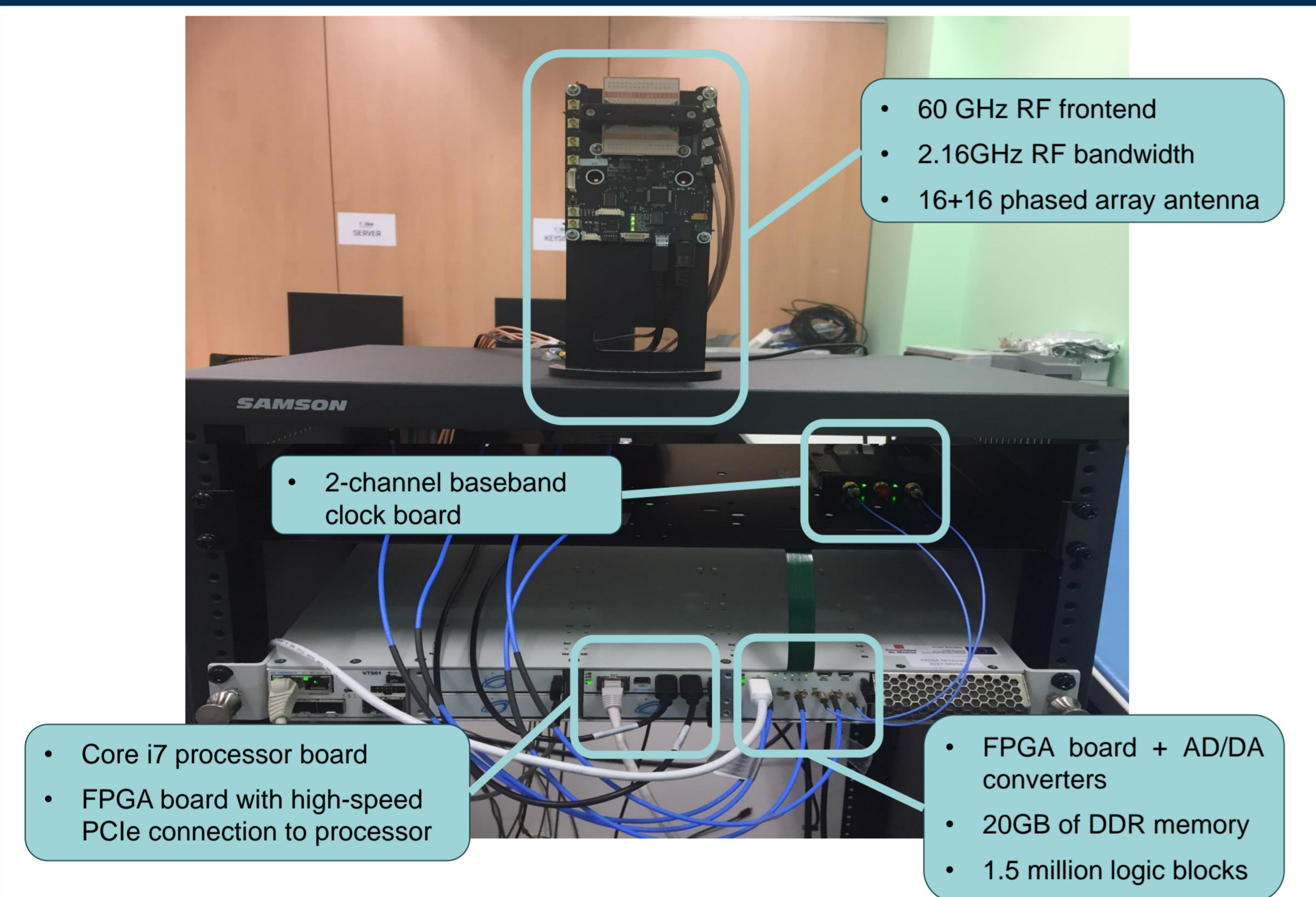
Wideband Millimeter-Wave Open Experimentation Platform

Jesús O. Lacruz, Diego Juara, Joerg Widmer
IMDEA Networks Institute

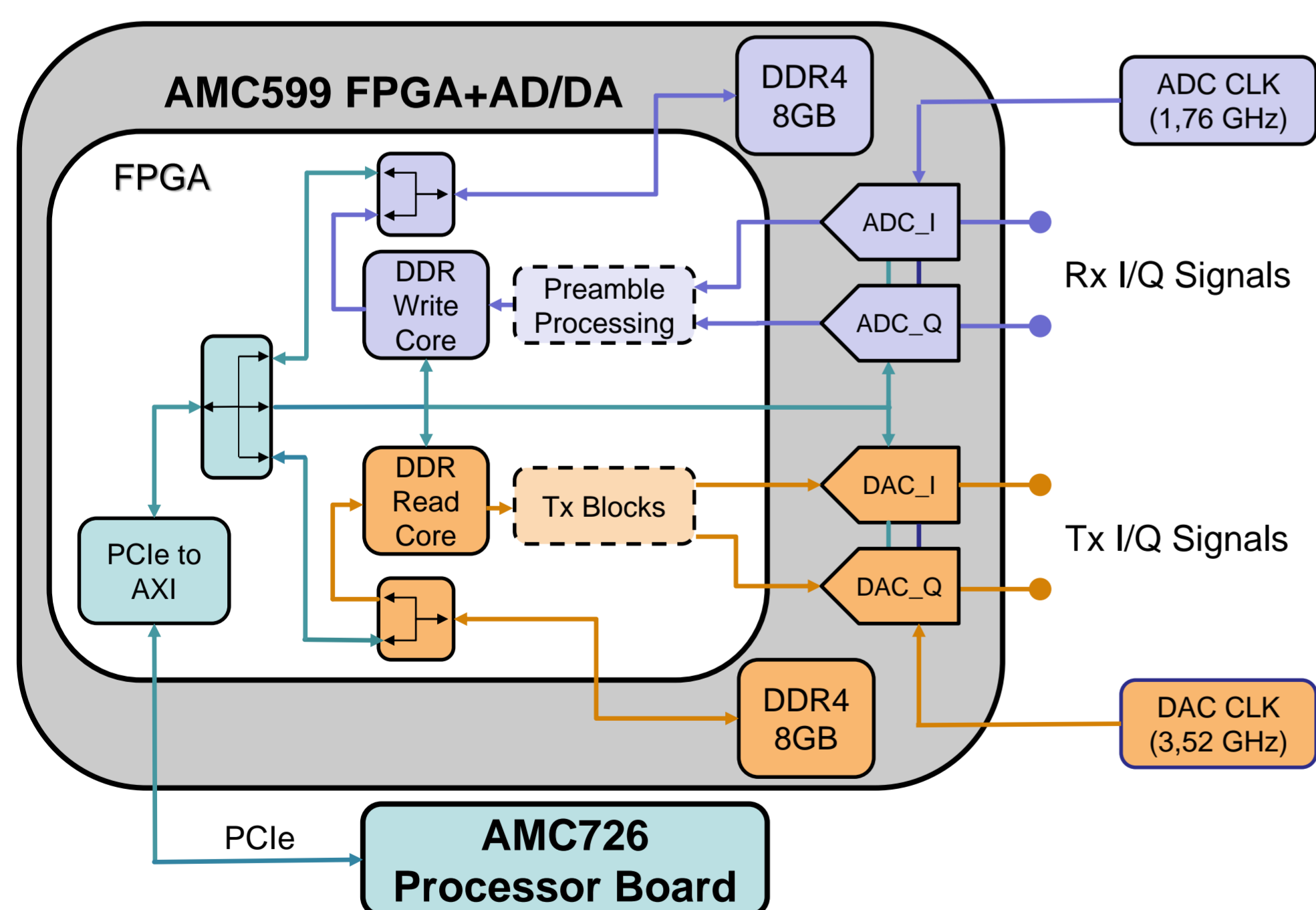
Highlights

- Flexible transceiver design using a *single* FPGA, simple and modular, with comparatively low cost.
- More than 2GHz bandwidth, compatible with 5G and beyond and 802.11ad/ay WLAN.
- Integrated with 60GHz RF frontend with phased array (16+16 antenna elements) and 6 bit phase-shift resolution for beamforming
- Up to 40m communication range for IEEE 802.11ad MCS12 single carrier frames (expected max. range around 100m for lower MCSs).
- Open-source hardware blocks compatible with scaled-down bandwidth systems (e.g., USRP X310).

Hardware Experimentation Platform



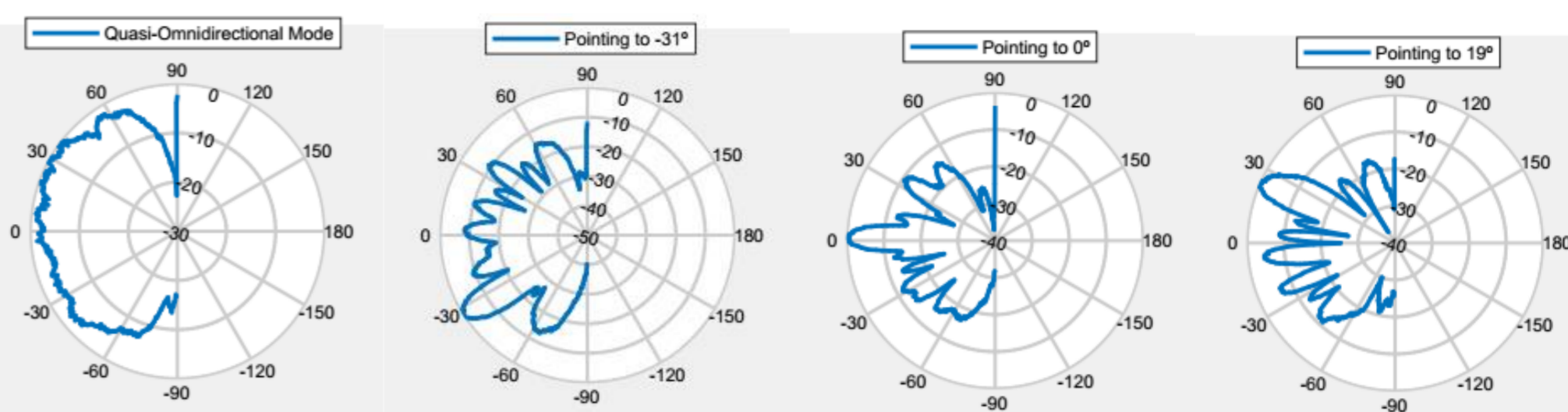
Baseband Transceiver Architecture



Phased Array Antennas

- Antenna Wave Vector with 64 beam patterns (selectable/updated through SPI from the FPGA)
- Full 2.16GHz IEEE 802.11ad channel bandwidth
- 6 bit resolution for phase, 4 bits for amplitude

Phased Array Antennas

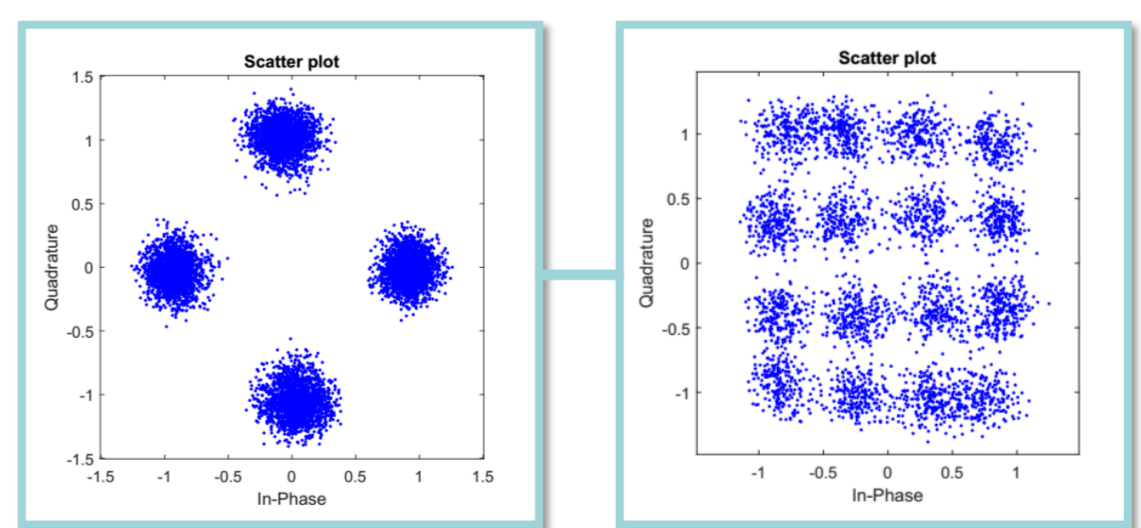
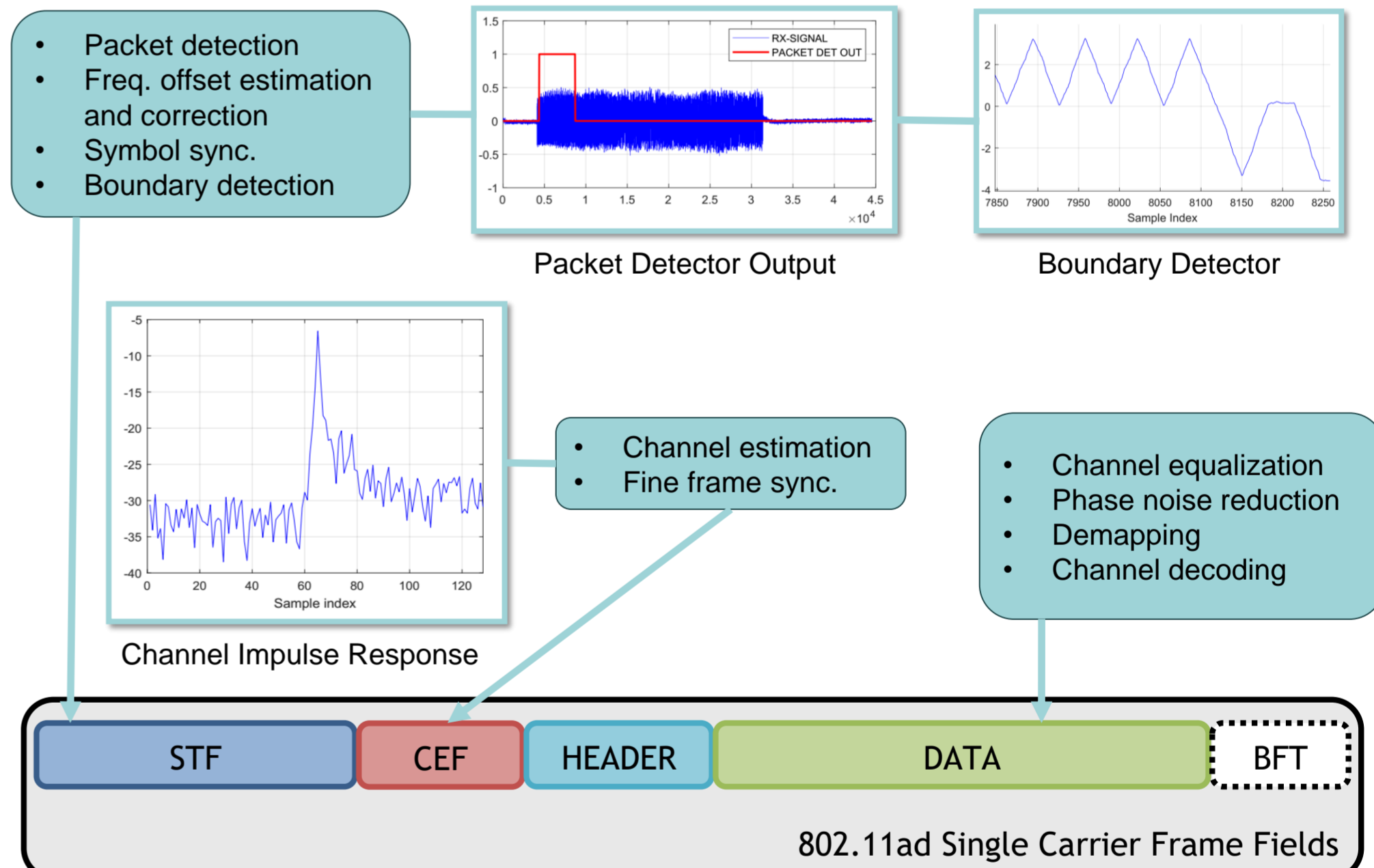
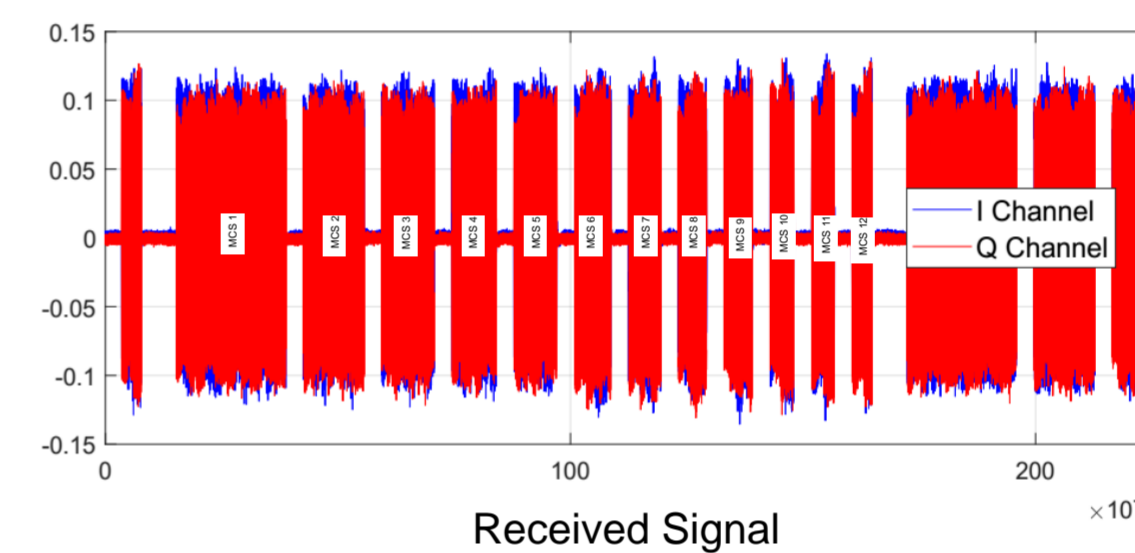


Example of four pre-defined beam patterns in the phased array antennas

Preliminary Experiments Results

Example setup:

- 20m LOS communication channel
- Transmission of fully standard compliant Single Carrier IEEE 802.11ad frames using MCS 1 to MCS 12
- Signal captured with the FPGA system and decoded offline using a MATLAB-based baseband receiver model.



Successfully transmission, reception and offline decoding over a 20m LOS link for up to IEEE 802.11ad MCS12 frames

On-going Work

- Step-by-step translation of the receiver processing blocks to the FPGA.
- Test a scaled-down system with reduced bandwidth in USRP X310 SDR devices (GNU-Radio + RFNoC framework).
- Extend the platform to low-order MIMO systems (multiple AMC599 boards in the same chassis).
- Exploit (limited) full-duplex capability for radar