Wideband Millimeter-Wave Open Experimentation Platform
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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
- 60 GHz RF frontend
- 2.16GHz RF bandwidth
- 16+16 phased array antenna
- Core i7 processor board
- FPGA board with high-speed PCIe connection to processor
- FPGA board + AD/DA converters
- 20GB of DDR memory
- 1.5 million logic blocks
- 2-channel baseband clock board

Baseband Transceiver Architecture
- FPGA
- DDR4 8GB
- ADC CLK (1.76 GHz)
- Rx I/Q Signals
- Tx Blocks
- DDR Read Core
- DAC_CLK (3.52 GHz)
- DAC_I
- DAC_O
- PCIe to AXI
- PCIe
- AMC599 FPGA+AD/DA
- AMC726 Processor Board

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

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.

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Preliminary Experiments Results
- Successfully transmission, reception and offline decoding over a 20m outdoor LOS channel for 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