Solution Brief

Military, Aerospace, and Government

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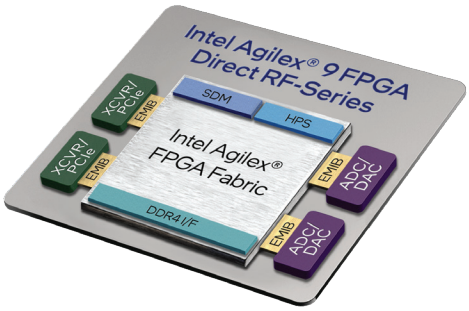
Altera® FPGA with Integrated Data Converter Technology



Addressing the Need of All-Digital Beamforming Systems

Executive Summary

Intel's next-generation FPGA technology integrates a high sample rate analog data converter with the FPGA fabric. With both analog-to-digital conversion (ADC) and digital-to analog conversion (DAC) capabilities and sample rates up to 64 GSPS this technology is a revolutionary step towards providing direct RF capability for radar, military, test & measurement, and wireless communications systems. This System-in-Package heterogeneous FPGA technology takes advantage of Intel's Embedded Multi-die Interconnect Bridge (EMIB) and the open standard Advanced Interface Bus (AIB) to seamlessly integrate an ADC/DAC chiplet with the FPGA fabric. This technology will consist of components made in USA, which is appealing to US military and government markets where offshore manufacturing is a concern.

Challenges

Today's beamforming platforms such as those used in radar and mission critical applications are designed such that 32 or more antenna elements share a single converter. These systems are now trending towards wider bandwidth 'all-digital' systems, where each antenna element is connected directly to an ADC and DAC. This architecture is becoming even more important to reduce the amount of data transmitted through a system and receive actionable intelligence for rapid decision making. It places back-end computing resources closer to the sensor, which is required to address future threats such as a drone swarm.

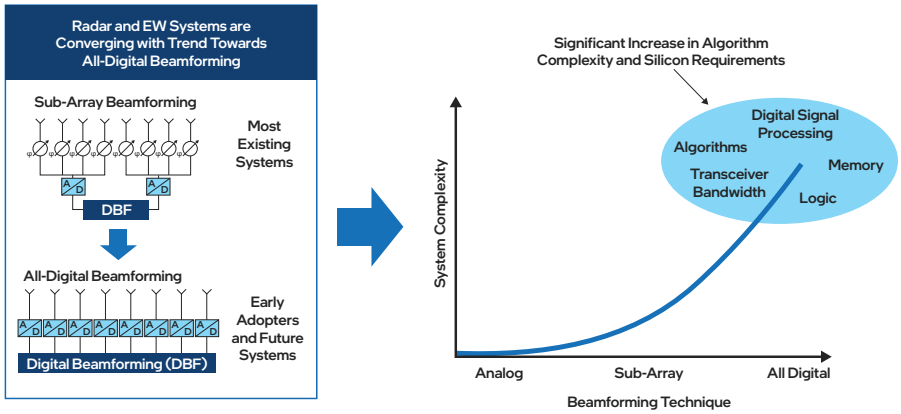


Figure 1 Transition to All-Digital Beamforming

These factors significantly increase algorithm complexity, requiring substantially more digital signal processing (DSP), memory, and logic FPGA resources. Conventional analog and RF systems employ RF to IF translation, which requires many analog components, and power hungry JESD204 protocol to connect ADCs and DACs to the FPGA. At the same time, radar and military systems are converging into the same platform with an emphasis on reducing size, weight, power, and cost (SWAP-C). This technology reduces all four.

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Solution

With the introduction of Intel® FPGAs with integrated analog data converter technology, the solution combines the components for direct RF conversion into a single package that leverages Intel's state-of-the-art heterogeneous packaging technology to connect chiplets from different processing nodes, including the ADC/DAC chiplet, to the FPGA fabric. This packaging technology connects chiplets using thousands of wires, each operating at 1 Tbps. This connection is accomplished using EMIB packaging technology and AIB physical layer protocol, which eliminates the need for SERDES or JESD204 protocols and draws only a fraction of the power.

This technology allows the combination of any number of advanced ADC/DAC technologies to be combined with the ideally matched FPGA fabric to create analog-data-converter-integrated FPGA products with varying high-performance analog and direct digitization capabilities that can be optimized for a variety of target applications, while driving performance and reducing SWAP-C.

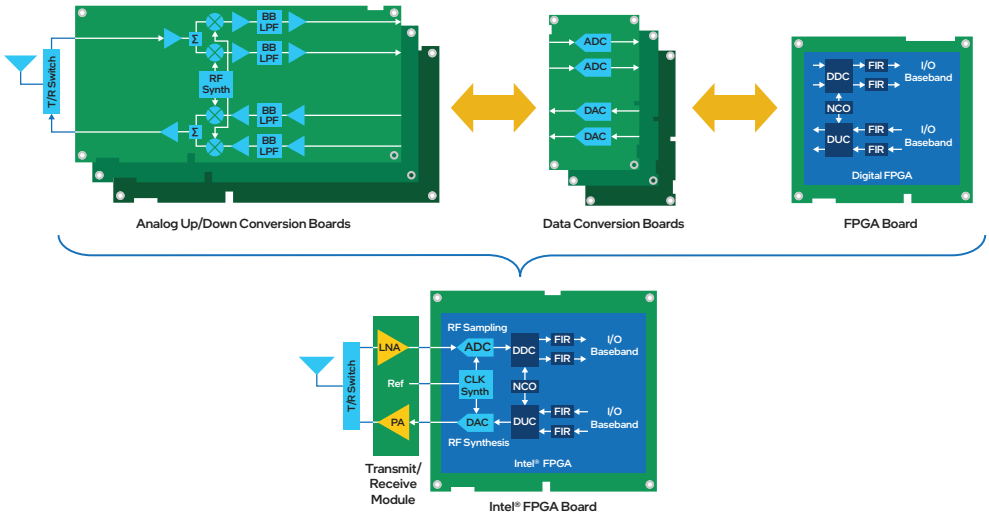

Figure 2 Block diagram of integrated solution showing reduction of analog components

The first offering that highlights this technology will also feature an analog data converter with input sample rates up to 64 GSPS. This offering will combine high-performance ADCs and DACs with a high-density, high-performance FPGA fabric and other dedicated transceiver chiplets in one package. These full-duplex data converter chiplets support 5X wider bandwidth than what competitive solutions can offer. They also provide frequency agility, up to 25 GHz of instantaneous bandwidth, a crucial differentiator for certain application segments. The data converter chiplets include Numerically Controlled Oscillators (NCOs) and integrated Digital Up Converters (DUCs) and Digital Down Converters (DDCs) that eliminate a substantial amount of analog circuitry. Combined, these innovations reduce board area, power, latency, and cost over an equivalent system made from discrete components.

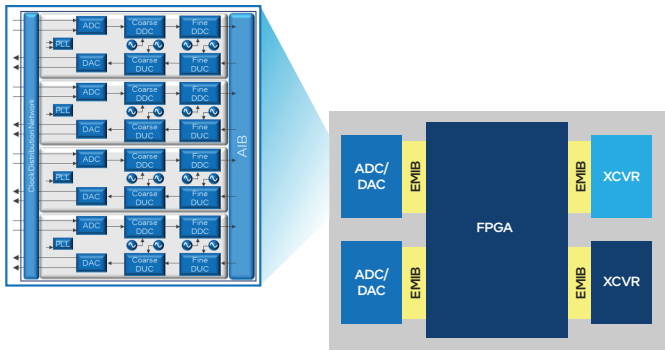

Figure 3 Schematic representation of the ADC/DAC converter chiplet

This high sample rate, wide bandwidth offering significantly differentiates itself from other products in the market and directly addresses the needs of the military, radar, high-end test equipment, and wireless communications markets.

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