NASA SBIR/STTR Technologies

S1.03-8314 - Low-power Cross-Correlator ASIC

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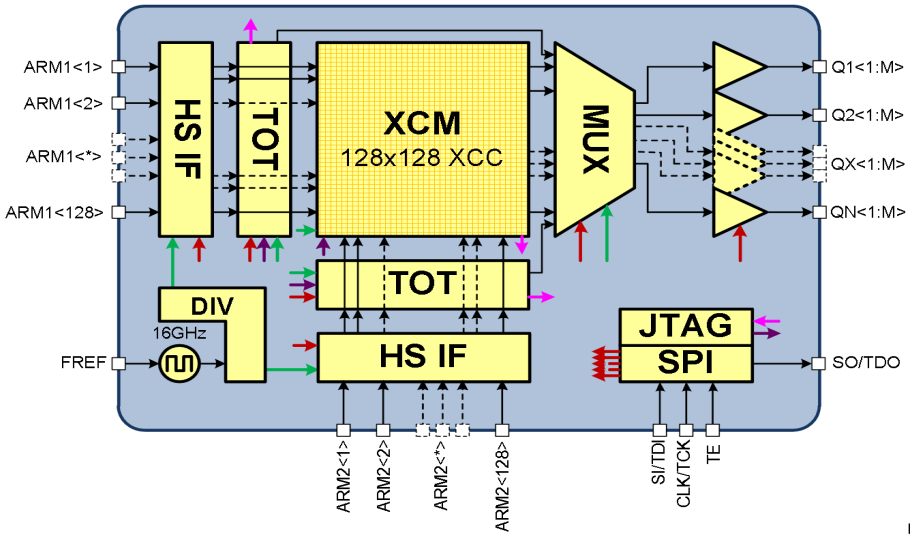
Identification and Significance of Innovation

Pacific MicroCHIP Corp. proposes to design a cross-correlator ASIC for the GeoSTAR's microwave sounder instrument. Compared to an FPGA based or a classic ASIC based systems, the proposed ASIC will greatly reduce the power consumption, will operate over extended temperature range and under high radiation. The proposed ASIC includes novel low power cross-correlation cells that function following the principle "work when must" instead of "work when need". High speed interfaces employed in the ASIC will help further reduce the power consumption and increase its reliability. Termination resistors, amplifiers and ADCs realized inside the ASIC will save power due to shorter interconnects compared to those used in FPGAs. The ASIC will be designed following the design-for-testability (DFT) methods that will simplify characterization and testing of the fabricated ASIC. Total ionizing dose (TID) immune and a latch-up free deep submicron SOI CMOS technology will be used for the ASIC's fabrication.



Estimated TRL at beginning and end of contract: (Begin: 1 End: 3)

Technical Objectives and Work Plan

Technical Objectives:
* To make the final selection of a commercial technology for the ASIC's implementation.
* To propose the architecture of a digitizer, Cross-Correlator, totalizer and to present a functional block diagram showing how the proposed architecture can meet the aforementioned requirements:
  .To select a high speed interface.
  .To minimize the power consumption of a cross-correlation cell.
  .To minimize the power consumption of a totalizer cell.
  .To select the structure of an output multiplexer.
* To validate the architecture and to prove the feasibility of the proposed block level implementation by using behavioral and system level simulations.
* To design the critical circuits required to demonstrate implementation feasibility of the proposed ASIC's architecture.
* To simulate/verify and provide the results proving the feasibility of the circuit level implementation based on the selected commercial technology.
* To provide a technical report summarizing the work that has been done.

Work Plan:
* Design of Analog-Digital Interface to ARM Signals.
* Cross-Correlation Matrix Cell and Totalizer Cell Implementation.
* Design of Buffer Supplying Signals to XCM and TOT.

NASA Applications

The proposed low-power Cross-Correlator ASIC will be employed in the GeoSTAR instrument's microwave sounder to cross-correlate the signals of 2X125 receivers located on two arms of the Y shaped antenna. A total of three ASICs will be employed in the instrument. The proposed ASIC can greatly reduce the power consumption of radio telescopes such as the SKA. The cross-correlators installed on these telescopes are currently projected to consume tens of kilowatts of power.

Non-NASA Applications

*Commercial and military systems such as radiometry, interferometry, polarimetry and spectrometry employed for remote sensing.
*Neural implants in medicine, image sensor signal processing in military and homeland security and for synthetic aperture radars in both military and civil aviation.
*Artificial eyes, ears or other senses that employ signal processing based on artificial neural networks.

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