4th URSI AT-RASC, Gran Canaria, 19-24 May 2024

Square Kilometer Array Mid Frequency Correlator / Beamformer Project Update

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The National Research Council of Canada (NRC) is leading the development and delivery of the Square Kilometer Array (SKA) Mid Frequency Correlator/Beamformer (Mid.CBF) signal processing system. This talk begins with an overview of the system architecture, schedule and progress for the small prototype systems, the TALON Demonstration Correlator (TDC). The TDC system is being delivered to the Mid Telescope site for Array Assemblies 0.5 / 1 and uses the NRC developed TALON signal processing hardware platform. The talk will continue with a description of the architecture changes for the production version of Mid.CBF that will be delivered for Array Assembly 2 and onward. The production correlator systems utilize commercial-of-the-shelf (COTS) servers, FPGA PCIe cards and 400 Gigabit Ethernet switches instead of custom designed FPGA hardware. Further, the production correlators will be located in the Science Processing Center in Cape Town, South Africa instead of the Central Processing Facility (CPF) located at the Mid Telescope site in the Karoo desert.

Functionality for the TDC systems includes correlation and Pulsar Timing beamforming for up to eight antennas and 800 MHz of instantaneous bandwidth. The system requires a total of four TALON line replaceable units (LRU) requiring a total of 8U of rack space. Integration and test activities are currently underway for the AA0.5 functionality that includes the correlation mode for four antennas. The target date for delivery of Array Assembly 0.5 to the Mid telescope site is Q4 of 2024.

Functionality for the final production Mid.CBF system includes the following:

- Correlation, Pulsar Search Beamforming, Pulsar Timing Beamforming and Very Long Baseline Interferometry (VLBI) Beamforming modes.
- Up to 200 receptor inputs allocated to up to 16 independent sub-arrays
- Up to 5 GHz of instantaneous correlated bandwidth
- Up to 1500 Pulsar Search beams (400 MHz bandwidth)
- Up to 16 Pulsar Search beams (2.5 GHz bandwidth)
- Up to 46 VLBI beams with up to 10 GHz total bandwidth across all beams

The talk will conclude with a brief discussion on prototyping results, development progress and future milestones.