



Contribution ID: 122

Type: not specified

Design of a Software Correlator for the Phase I SKA

Wednesday, 24 March 2010 16:20 (15 minutes)

Phase I of the SKA will comprise of about 10% of the final collecting area. It is likely that a software correlator will be used for early science. Assuming 300 antennas, 4 GHz bandwidth, and two polarizations, the required performance of the software correlator for auto and cross correlations is 5.76 Peta FLOPS (Floating Operations Per Second), which is just about three times larger than that of the current fastest supercomputer in the world. Considering the near future technology developments, we designed the software correlator based on a cluster with multi-core processors and possibly graphic processing units (GPUs). Since the data rate from an antenna with a single pixel feed is 64 Gbit/sec (two polarizations, 4bit Nyquist sampling of 4 GHz bandwidth), a simplest possible network topology between antennas and computer nodes is point-to-point connections with 100 Gbit/sec ethernet. Due to the increase of number of bit for a sample after its fourier transform, the bandwidth of interconnections of computer nodes might be 4 or 8 times larger than the input data rate to each node. The cluster is composed of 300 computer nodes, and the performance of each node should be better than about 20 Tera FLOPS. We also estimated the expected performance, cost, and power usage of a 300 node GPU cluster with current technology.

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Session Classification: Signal Transport, Signal Processing, Software, & Data Management

Track Classification: Signal Transport, Signal Processing, Software, and Data Management