ASKAP Advancements in Beamformer and Correlator Optical Backplane Technology

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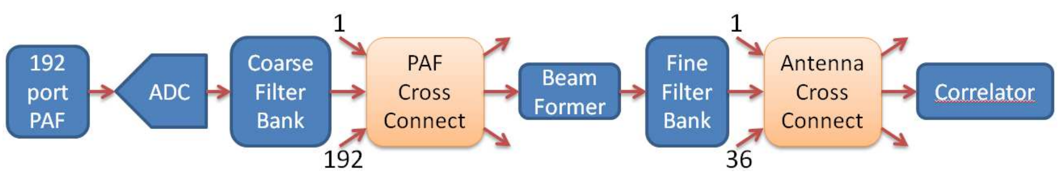
The Australian Square Kilometre Array Pathfinder (ASKAP) is an array of 36-antennas located in Western Australia. Each antenna is outfitted with a 192-port phased array feeds (PAF) which targets wide field of view radio astronomy. Both PAFs and Correlators require backplanes to cross connect data inputs; in the case of a PAF its 192-ports into the Beamformer, and then for the Correlator its 36-antenna inputs. For ASKAP these digital cross connect communications require approximately 300Tbps – the aim is to do this as efficiently as possible (power, cabling, RFI and programming.). This paper explores existing solutions and also describes advancements in the second generation ASKAP hardware using optical backplane technology. These technology steps will become critical for SKA which will consist of many orders of magnitude more antennas than ASKAP, and may also potentially use PAF technology.



The second version of ASKAP hardware is significantly different in that all digital hardware is located at the same central site building. This enables the use of low cost and power parallel optics modules which can be combined with high density multi-mode optical ribbon fibre. Ribbon fibre reduces the number of optical cables by an order of magnitude. The second generation ASKAP boards for digitization and DSP have made steps to also reduce communications power. This reduction is facilitated by increasing the density of devices per board. The digitization board now accepts 16 PAF ports per board, whilst the DSP boards have increased to six FPGAs per board. Next generation FPGAs have been used to further increase processing density. In order to balance signal processing capability with the communications bandwidth, FPGA transceivers now operate at 10Gbps. The high cross connect bandwidths are implemented using low cost optical circuitry. It is possible to lay individual fibres on a Kapton substrate in a similar manner as copper traces are placed on circuit boards. The advantage of optical circuitry is that there is very little signal loss and no electrical power is required. The full version of this paper will describe in more detail the optical cross connect and the ASKAP signal processing hardware and firmware.