Receiver Architecture for Second Generation ASKAP

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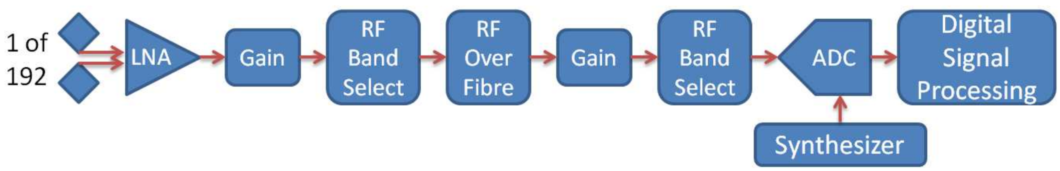
A second generation receiver architecture for the Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope has been developed. This new receiver design has many differences to the initial BETA dual heterodyne receiver architecture (design circa 2008). Significant differences include direct sampling of RF signals as well as replacing RF transmission over coax with optical fibre. Both receivers interface to an uncooled low noise 192 element Phased Array Feed (PAF) which targets wide field of view radio astronomy. Pivotal to the new receiver design is analog only signal processing at the antenna (36x12m dishes) and full relocation of all DSP (including the ADC) to a central site RFI shielded building of up to 7kms away. This architecture will set new benchmarks in both antenna simplicity and radio quietness.



Relocation has made possible an instantaneous bandwidth exceeding 500MHz over the 700 to 1800MHz instrument range through the use of direct detection intensity modulated high dynamic range RF over Fibre (RFOF) links. These optical links operate at 1310nm on high density standard single mode ribbon fibre. The cost of Commercial Off The Shelf (COTS) optical components has reduced considerably. The uncooled distributed feedback laser (DFB) is a key optical component offering low relative intensity noise (RIN), usable slope efficiency and good linearity, all critical for a high dynamic range RFOF links. The interest in low cost high performance RFOF for radio astronomy applications, such as the SKA where the number of remote receptors is measured in thousands, has grown significantly over the past few years.

The latest in 12bit 1600MS/s 3GHz RF input Analog to Digital Converter (ADC) COTS chipsets directly sample the RF in the central site building. The input BW is divided into three astronomy bands to avoid high ADC sampling rates and maximize dynamic range. Next generation FPGAs combined with optical cross-connects completes an all optical based mixed signal receiver architecture. This is a bold step forward for systems of this size and scale in radio astronomy. The full version of this paper will describe the end-to-end cascade analysis of the receiver in detail and present more implementation specifics.