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Station Signal Processing System for the SKA-Low: status, plans and India's role

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Abstract
The Square Kilometer Array (SKA) is a next-generation radio telescope being constructed by an international consortium involving academia and industry, with headquarters near Manchester, UK. The SKA is overseen by the SKA Observatory (SKAO)-an intergovernmental organization. The SKA construction started in 2021, costing ~€2-billion, over 10-years (2021-2030), construction: 7-8 years, commissioning: next 2-3 years, early science, and stabilisation.

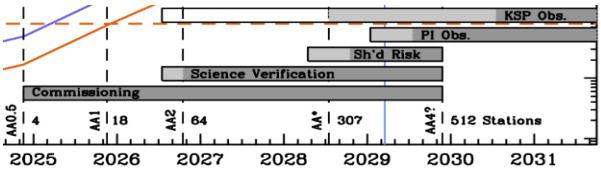

Figure 1: SKA-Low Timeline

The SKA-Low is an aperture array located in Western Australia's Murchison shire will be consisting 131,072 dual-polarization antennas grouped into 512 stations, transmitting signals to the Central Processing Facility for processing in the Signal Processing Subsystem (SPS) consisting of Front-End Module, Tile Processing Module (TPM) doing complex beamforming.

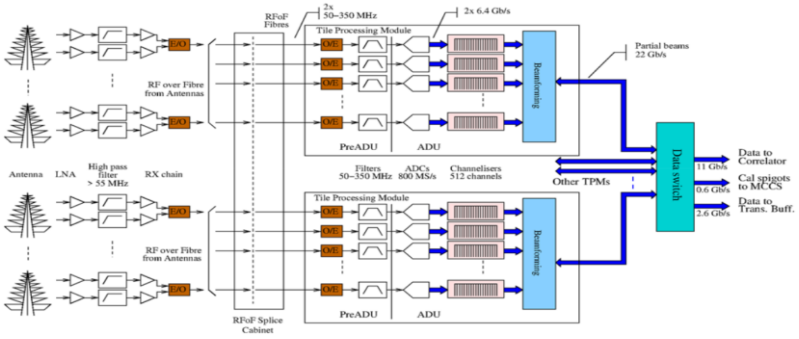

Figure 2: SKA-Low Signal Chain for the Low Telescope

India, leveraging expertise from the NCRA, RRI, and industrial partners, shown interest in SKA. Recently, the Indian government approved the proposal to join the SKAO as a member country and participate in the construction phase.
Italy leads the construction phase, with India as a major contributor to digital sub-systems. India will fabricate, assemble, integrate, test, and deliver subracks with TPMs for SKA-Low, in collaboration with Indian industry and research organisations. The TPM is highly complex board featuring advanced ADCs, FPGAs, memory, multi-gigabit QSFP, and multilayer PCB, requiring rigorous quality inspection, validation, and testing. Each subrack, consisting of 8-TPMs,that processes 256-dual-polarization antennas. India is expected to contribute ~2048-TPMs and 256-subracks over next 3-6 years.
NCRA/RRI is identifying and evaluating capable Indian manufacturers for the SKA project while adhering to the international SKA-Low timeline and industrial standards ensuring additional opportunities within the SKAO framework.

Keywords: beamforming, digital sub-system, Indian manufacturers, TPM, SKA