

Antenna Electronics Concept for the Next-Generation Very Large Array

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The National Radio Astronomy Observatory (NRAO) completed two major projects this decade: the sensitivity upgrade for the Karl Jansky Very Large Array (VLA), and construction of the Atacama Large Millimeter/Sub-Millimeter Array (ALMA), in collaboration with international partners.

The VLA has proven to be one of the most productive radio telescopes in the centimeter wavelengths. The NRAO is now investigating the future of centimeter wavelength astronomy in the northern hemisphere, spanning the gap between thermal and non-thermal emission mechanisms, and bridging the capabilities of ALMA and SKA.

The scientific potential and technical feasibility of a next-generation VLA (ngVLA) is presently being assessed. Preliminary goals for the ngVLA are to increase both the system sensitivity and angular resolution of the VLA five to tenfold, and frequency coverage spanning 1 GHz to 120 GHz.

A number of key technical challenges have been identified for the project. These include cost-effective antenna manufacturing (in the hundreds), suitable wide-band feed and receiver designs, broad-band data transmission, and large-N correlators. Minimizing the overall operations cost is also a fundamental design requirement.

The design of the antenna electronics, reference distribution and data transmission systems are anticipated to be major construction and operations cost drivers for the facility. The electronics must achieve a high level of performance, while maintaining low operation and maintenance costs and a high level of reliability. Additionally, due to uncertainty in the feasibility of wideband receivers, advancements in digitizer technology, and the availability of funding, the architecture should be scalable to the number of receiver bands and the speed and resolution of available digitizer ICs.

The focus of the presentation will be the projected performance requirements and a proposed block diagram for the electronics system, parameter tradeoffs within the system specification, and areas of technical risk where technical advances may be required for successful production and installation.