

SETI Instrumentation for Breakthrough Listen

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The Breakthrough Listen project is a full-sky search for extraterrestrial intelligence that is orders of magnitude more comprehensive than previous efforts in terms of sky coverage, bandwidth, and sensitivity. With substantial dedicated observing time on some of the world's most powerful radio telescopes, the signal processing and data handling demands for Breakthrough Listen will be challenging.

The basic concept of the initial Breakthrough Listen back-end is to record voltage data during on-sky observing time and then to analyze those data during the time between observing sessions. During observations, the analog IF signals will be digitized by analog to digital converters (ADCs) connected to field programmable gate arrays (FPGAs). The FPGAs will channelize the signals and send them through an Ethernet switch to computers known as "compute nodes" where the received data will be stored in a large disk buffer along with corresponding metadata from the observatory. After the observing session ends, the data will be analyzed in situ on the compute nodes and any signals of interest will be saved to persistent disk storage on other computers known as "storage nodes". Real-time analysis will be performed when data are being buffered to disk as throughput permits.

The first two telescopes that Breakthrough Listen will use are the Robert C. Byrd Green Bank Telescope (GBT) in West Virginia and the Parkes Telescope in Australia. While the overall architecture will be similar at all telescopes, each telescope and observatory has unique features that will necessitate some site specific care and handling. The general and site specific implementation details of these systems are presented along with an overview of the project schedule and a candid recounting of the inevitable lessons learned.