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Commensal, Multi-user Observations with an Ethernet-based Jansky Very Large Array

Cherry Ng*[1,2,3], Jack Hickish[1], Tony Beasley[4], David R. DeBoer[3], Paul Demorest[4], Alan Erickson[4], Andrew P. V. Siemion[1,3,5] and Kenneth M. Houston[3]
(1) SETI Institute, Mountain View, CA, USA; e-mail: cng@seti.org
(2) Dunlap Institute for Astronomy & Astrophysics, ON, Canada; e-mail: cherry.ng@dunlap.utoronto.ca
(3) Department of Astronomy, University of California, Berkeley, CA, USA
(4) National Radio Astronomy Observatory, Socorro, NM, USA
(5) Dept. of Physics & Astronomy, University of Manchester, Oxford Road, M13 9PL, UK

Extended Abstract
We propose to develop a commensal observation capability on the Jansky Very Large Array (JVLA) by deploying a multicast Ethernet-based interface and a dedicated digital signal processing cluster. The complete system is dubbed "COSMIC" - the Commensal Open-Source Multimode Interferometer Cluster. COSMIC will bring about a paradigm shift for JVLA operations in which multiple subscribers can carry out multiple diverse research projects simultaneously, maximizing the potential scientific output.

An early design of COSMIC was presented in [1]; the system has since then been further developed in collaboration with the National Radio Astronomy Observatory (NRAO). In summary, the technical objectives of COSMIC are two-fold. Firstly, we propose to implement a system capable of translating the digital data streams from the JVLA antennas to a multicast Ethernet protocol. This will be a full-time commensal data source that is creating a copy of all JVLA data in real time. The input data will be sent to commercially available FPGA hardware, where they can be channelized and re-emitted using a 100 Gb Ethernet data link layer. Secondly, we will implement a flexible, multi-functional compute cluster to process the multicast data, using off-the-shelf CPU/GPU hardware and modular signal processing software developed by the COSMIC team. The initial deployment proposed here will support up to 2-GHz bandwidth dual-polarization real-time processing with both high spectral resolution and high temporal resolution modes. The data ingestion rate will be over 1.6 Tb/s, making this the highest data rate Ethernet distribution system in radio astronomy.

In this talk, we will provide an overview of the design of COSMIC as well as the status update on the commissioning progress. COSMIC is expected to operate alongside latter portions of the third epoch of the VLA Sky Survey (VLASS) [2]. Its high spectral resolution mode will be used to conduct the deepest and widest sky survey for radio technosignatures ever completed. Additionally, the system will make possible a commensal search for Fast Radio Bursts (FRBs) with significantly improved sensitivity over the extant Realfast [3] system. When completed, COSMIC will ensure critical continuity during the transient period from the JVLA to the Next Generation VLA (ngVLA) era. COSMIC will also act as a technical and programmatic pathfinder for deploying commensal observation capabilities on the ngVLA. In the long term, COSMIC will be managed as shared-risk user equipment and has the possibility of serving a wide range of scientific interests in the field of radio astronomy.

References

[1] J. Hickish, et al., "A Decade of Developing Radio-Astronomy Instrumentation using CASPER Open-Source Technology," *Journal of Astronomical Instrumentation*, **5**, 4, pp. 1 641 001–12, Dec. 2016.

[2] M. Lacy, et al., "The Karl G. Jansky Very Large Array Sky Survey (VLASS). Science Case and Survey Design," *PASP*, **132**, 1009, pp. 035001, Mar. 2020.

[3] C. J. Law, et al., "realfast: Real-time, Commensal Fast Transient Surveys with the Very Large Array," *ApJS*, **236**, 1, pp. 8, May 2018.