Incoherent clocking and application to the ngVLA

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Radio interferometers are coherent instruments requiring synchronization of all signal processing to a coherent clock prior to correlation and (optionally) tied-array beamforming. Ideally, digitization occurs as close to the feed as possible for maximum stability and signal fidelity. Currently, to provide this capability specialized laser and optical methods are employed in round-trip LO delivery systems to provide each receiver with a coherent clock, phase-locked to a common reference, for (optional) down-conversion and digitization. This method works well but may have limitations in baseline length and, for some applications, may be cost prohibitive. Here, a method (Carlson, IEE *Electronics Letters*, Vol. 54, No. 14, 12-July-2018) is proposed whereby a) each receiver operates using its own free-running clock not locked to a central reference clock, b) the phase and frequency of the clock is measured at a central site relative to a common reference by transferring at least a 'trace' of its behavior to the central site, and c) the digitized science data is digitally corrected at the central site, by applying knowledge of the antenna clock's behavior, before correlation and beamforming. Possible application of this method to the ngVLA using all COTS digital methods and digital fiber-optics, as well as the current state of research into this method, including computer modelling and development of a laboratory demonstrator using the Xilinx ZCU111 RFSoC evaluation kit, is described. If successful, this method may open up new possibilities for providing at-receiver digitization in cost sensitive applications, and permit much longer baselines for extended arrays such as the ngVLA and telescopes not yet envisioned.