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Beam Synchronous for the Rest of Us!

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Fermilab's Tevatron Clock (TCLK) infrastructure has been an integral part of the accelerator control network since the 1980's. This 10MHz Manchester encoded protocol has enabled flexible, real-time event distribution for thousands of devices connected to the timing network with a high degree of reliability.

Forthcoming upgrades to the Fermilab complex (PIP-II, LBNF, ACORN) necessitate higher levels of precision to maintain inter-bunch timing for Instrumentation and Control purposes. This presents as an opportunity to refine the event distribution protocol for tighter synchronization between machines, experiments, and eventually far-site operations.

This paper outlines a method by which beam-synchronous events may be distributed through asynchronous serial protocols via integration with local LLRF and global PPS reference signals. This method is ideal for synchrotron machines with aggressive frequency sweeps (such as Fermilab's 38~53MHz Booster) and allows for precision timing to be maintained across machines without specialized hardware.

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