Hardware Interlock System sbRIO Time Synchronization

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2022-05

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I investigated, debugged, and implemented time synchronization for the RICH-2 hardware interlock system's sbRIO.

After requesting the temperature, humidity, airflow, air pressure, and nitrogen flow measurements of the hardware interlock system be added to JLab's MYA archival system, it was noted that despite the PVs successfully being implemented in the archiver, the data was not being correctly logged. Upon investigation, it was determined that the cause of the issue was an offset of the sbRIO clock with respect to the archiver's clock where the sbRIO time was about five minutes faster than the JLab's time reference.

First, the sbRIO's time was manually synchronized via NI's Measurement & Automation Explorer (NIMAX). However, the next day, the time on the sbRIO had reverted to being five minutes in the future.

The next thing attempted to synchronize the sbRIO and Jlab time reference, network time protocol (NTP) was installed and configured on the sbRIO. Unfortunatley, this had no effect on the time synchronization of the sbRIO and JLab time reference.

Next, I tried using Precision Time Protocol (PTP) to synchronize the sbRIO with the JLab time reference. This was done using the NI-Sync configuration subVIs from NI. First, I had to disable the sbRIO's default configuration to rely on its internal clock for its time and then enable synchronization to external timeclocks. Next I had to configure the sbRIO to be a peripheral timeclock and receive its time from an external, main time clock. As of May 17, this PTP configuration has been successful and data has been successfully archived.

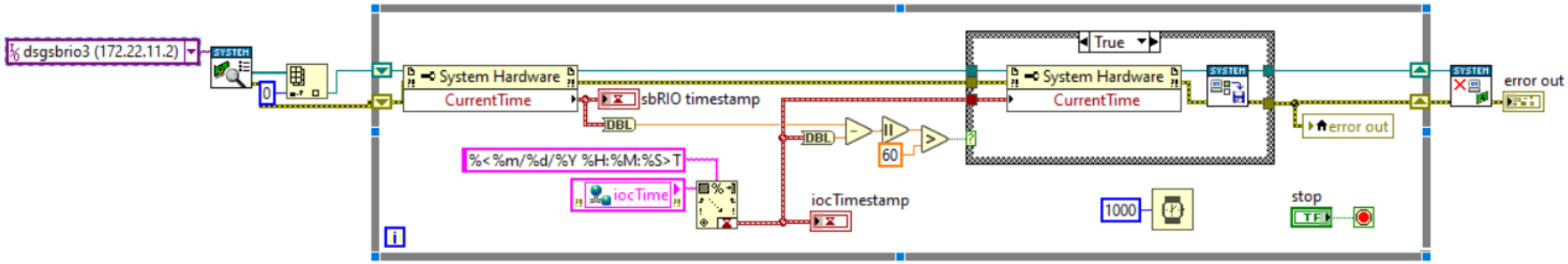
- **Goal was to synchronize RICH-2's hardware interlock system's sbRIO with a JLab time reference to resolve archiving issues caused by time discrepancy.**
- **Three methods were tried to synchronize the sbRIO with a JLab time reference:**
  - **Manual time synchronization via NIMAX**
  - **NTP synchronization**
  - **PTP synchronization**
    - **Successful**
- **Alternate method investigated using RICH scalers IOC time PV**

New Mirror Reflectivity Test Station

In the event that PTP synchronization stops working, a “semi-automatic” time synchronization method was investigated using DSG’s spare sbRIO. This alternate method of synchronization can be considered semi-automatic because while it is done programmatically by the sbRIO, it is the equivalent of doing a manual synchronization in NIMAX. This method uses logic developed to periodically check the sbRIO’s time against the time from Hall B’s RICH scalers IOC.

To read the PV that corresponds to the IOC’s time, an EPICS client has to be configured on the sbRIO. Afterwards, the PV (whose datatype is a string) can be read by the sbRIO, converted to an NI timestamp datatype format, and finally converted to seconds elapsed since 00:00:00 UTC on January 1, 1904 (LabVIEW time epoch format).

The sbRIO’s timestamp is also converted to LabVIEW time epoch format and compared to the IOC’s time. If the magnitude of the difference between the sbRIO’s time and the IOC’s time is greater than 15 seconds (or the user-settable limit) the IOC’s time in timestamp datatype is set as the sbRIO’s time.



Block diagram of LabVIEW code used to test semi-automatic time synchronization.