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Telemetry Dynamic Simulator (TDSIM)

Sync IRIG Time with Archived Data
Verification Procedure and Results

This document describes the verification procedure and test results for synchronizing the archived playback data with IRIG generator time.

IRIG time cannot accurately be synchronized with the archived data without hardware in the loop to continually align it. It can, however, get close. Close is defined as "within 10 milliseconds". The data is clocked out of the TDSim at the bit rate defined by the user. The relative time of the data clocked out is with an error of 1E-05 seconds of the bit rate selected. The bit rate of the data archived is also within the 1E-05 seconds. These two clocks are not tied to each other, so there could be an error of 1E-04 seconds in the relative time of the data output to the relative time of the data archived. Now, couple those two errors with the error in the IRIG generator, which uses a different clock, and you can see how the errors can compound.

The relative time of the data is what most people care about, which is worst case a 1E-04 error, but for those of you that want the IRIG generator time really close to the archived data time, some 'extra' routines were added to the program to help it get close.

The 10 milliseconds accuracy is used because the IRIG generator must be seeded on a 1 second boundary, and the delay output from the TDSim can only be set to the 10 millisecond boundary. This is a hardware limitation. The test results indicate a better accuracy can be achieved, but since there are so many other factors that can contribute to the latency, 10 milliseconds is a safe bet.

Also, since the LS7x card only has a single IRIG generator on the card, if your card has 2 channels, then only channel 1 can be used.

Verification Procedure

I) Gather truth data. The first thing we've got to do is get some data to test with. This will generate a PCM stream of data from the SuperSim and we'll archive it on LDPS. The data generated will be such that you can verify you are looking at the correct minor frame of data on the verification step. We'll create two tests, one relatively slow, and one moderately fast.

1. Set the Data Mode on the SuperSim program to USER.
2. Set the SuperSim PCM Setup as follows:
    a. Words Per Frame – 256

b. Common Word Length – 16
c. Number of minor frames – 64
d. SFID Start Count – 0
e. SFID Count Direction - Up
f. SFID Word Number – 3
g. SFID MSB – 5
h. FSP Length – 24
i. FSP Location – Leads
j. FSP – FAF320
k. Bit Order – MSB First

3. Create 2 Wave words in the SuperSim PCM setup (override the default setup)
    a. Word 4 – A Ramp Up word, counting from 0 to 100, complete cycle in 101 minor frames, changing once per minor frame.
    b. Word 5 – A Sin Wave word, counting from 0 to 129, complete cycle in 130 minor frames, changing once per minor frame.
4. Create a project on LDPS using the same PCM setup information, using a default parameter data base, ensuring the IRIG reader is setup to get data from external.
5. Connect the LS7x card to the LS50 card so the LS50 gets data from TTL, and the IRIG reader on the LS50 is connected to the IRIG generator on the LS7x.
6. Load the project on LDPS.
7. Set the bit rate on the SuperSim to 102400. This will result in a minor frame update rate of 0.04 seconds (25 Hz, a relatively slow stream)
8. Start the output of data on the SuperSim, verify LDPS is getting data, including IRIG time.
9. Start recording data on LDPS. Record for about a minute or two, then close the project.
10. Set the bit rate on the SuperSim to 1024000. This will result in a minor frame update rate of 0.004 seconds (250 Hz, a moderately fast stream).
11. Load the project on LDPS again and start recording for a minute or two, then close the project.

12. Put LDPS into playback mode and load the first recorded project (from step 9 above).
13. Start the Client, and build a display containing Stream Time, and words 3, 4, and 5. This would be the SFID word and the two wave words.
14. Push the Play button on the Sever (ensure not in Step mode), then start archiving the display on the Client. (Save to *TruthSlow*).
15. Close the project on LDPS and open the project archived in step 11 above.
16. Load the Client display again.
17. Push the Play button on the Server, then start archiving the display on the Client. (Save to *TruthFast*).

II) Playback the archived data through the SuperSim and synchronize the IRIG time with the archived data.

1. Put LDPS into Live mode and load the project.
2. Put the SuperSim into Playback mode. Ensure you are not overriding any words.
3. On the SuperSim:
    i. Load the first archived project
    ii. Press the Output Data button.
    iii. Click the Sync IRIG button
4. On LDPS
    i. Open the Client display screen created in Step I-13 above.
    ii. Archive the data on the Client (Save to *PbkSlow*)
5. On the SuperSim:
    i. Load the second archived project
    ii. Press the Output Data button
    iii. Click the Sync IRIG button
6. On LDPS
    i. Archive the data on the Client (Save to *PbkFast*)

III) Compare the playback archived data with the truth data. At this point you have two truth data reduction files and two playback data reduction files archived with the Client. Now you have to find a series of word values in the truth file and then find that same series of numbers in the playback file. Then you can look at the frame timestamps and get the delta between truth and playback.

The wave words (word 4 and 5) were set so the chances of all three values is pretty slim for the minute or two the data was archived, around the same timestamps. Using NotePad, open the truth file, find some set of the 3 words you want to measure. Highlight those 3 words, copy to the clipboard, then open the playback file. Do a Find in the playback file and paste from the clipboard those values. Now, compare the values above and below the desired frame and ensure they match. Then write down the timestamps from each of the two files.

IV) Repeat steps II and III several times, pressing the Sync IRIG button at different times during the playback.

Test Results

The results of the procedure above prove the IRIG generator time can be synchronized with the archived data to within 10 milliseconds.

1. Slow Test Results, the delta time varied in the 2 to 3 millisecond range.
2. Fast Test Results, the delta time varied in the 7 to 8 millisecond range.