How to use an external trigger to sync a Shimmer with an external system

Shimmers can be synchronised with an external system using an External Expansion board or by using a Proto3 Deluxe, This document assumes the use of an external expansion board and assumes the external system is a Qualisys motion capture system.

How this would work is:

1. The customer would use one dedicated trigger Shimmer as the link between the Shimmer data and the Qualisys data
   a. By connecting the external expansion board to the dedicated trigger Shimmer and the Qualisys trigger to the external expansion board.
      i. **Note:** The maximum range of the Shimmer ADC is 3V so the external trigger voltage must not exceed this and must be stepped down if it does exceed 3V.

2. Ensure the real time clock (RTC) is set on each Shimmer by docking the Shimmers in a Dock or Base. This associates the PC time with the Shimmer time and enables real world timestamps to be recorded with the Shimmer data (see section 5.3 here for more detail). This will ensure all Shimmers record data according to a common clock i.e. the PC clock.
   a. **Note:** The real-world time is saved in volatile memory. This means that, if the Shimmer is powered off or reset, the real-world time will be lost.

3. **This step may not be necessary if using step 2.** Start all Shimmers logging and wait until they have successfully synchronised with the master Shimmer.
   a. Synchronisation of Shimmers when logging data to the SD card is a master/slave technique. One master (defined when configuring) and the rest slaves.
      i. The blue LED remains turned ON on slave Shimmers when un-synced and will turn off when synced.
         - This could take awhile especially if using a high volume of Shimmers, we've never synced such a high a number as 17 so this could be an issue.

4. Send a trigger from the Qualisys system, e.g. to mark the start and end point of a dataset
   a. This trigger data along with a timestamp will be recorded in the data channel of the dedicated trigger Shimmer.

5. The customer would then find the trigger and the associated timestamp in the data file of the dedicated trigger Shimmer and use this to extract datasets from all of the other Shimmers in post-processing
   a. This should work if all Shimmers are synchronised to the master as they will have all recorded to a common clock.

Note: The accuracy of the trigger is dependent on the sampling rate of the dedicated trigger Shimmer. If the dedicated trigger Shimmer sampling rate is 51.2Hz, the accuracy will be 1/51.2 => 0.019s or if the Shimmer sampling rate is 1024Hz, the accuracy will be 1/1024 => 0.0009s