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[EVT-AN01-SYNC]

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1.0.1
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Overview

This application note describes the mechanism by which multiple Emergent cameras can be synchronized. Figure 1 : System Hardwarebelow illustrates the hardware involved:

- Emergent cameras connected to Myricom Sync NICs via SFP+ cabling(fiber, direct attach).
- Myricom Dual Port Sync NICswith SMB IRIGB00X input in one or more PCs.
- IRIGB00X Timecode Generator using either GPS or internal based timecode.

The Myricom Dual Port Sync NIC is described here.
https://www.myricom.com/products/network-adapters/10g-pcie2-8c2-2s-sync.html

The Myricom NICs are supported by their MVA software/firmware solution as described here:
http://www.myricom.com/solutions/industrial-imaging.html

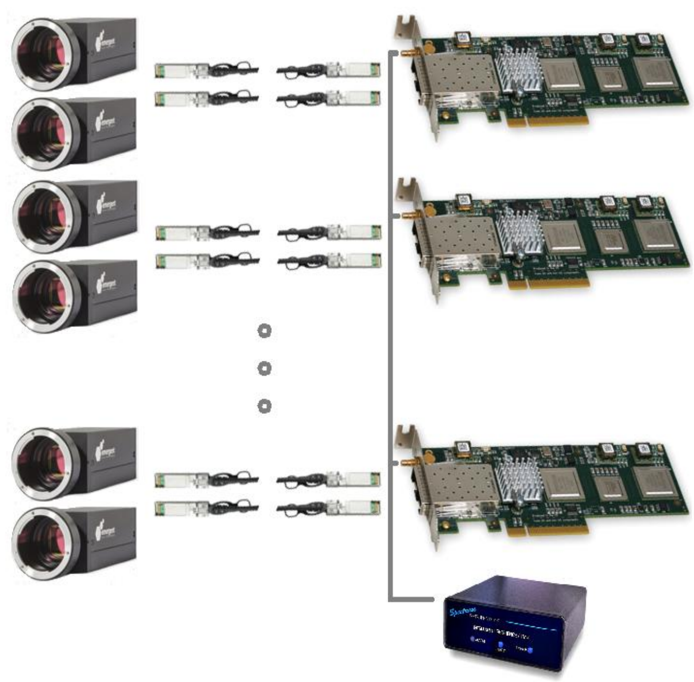


Figure 1 : System Hardware

The role of the IRIG generator is to supply a stable and equal time source to all Sync NICs and the Sync NICs in turn will timestamp frames from all cameras before passing these frames with timestamp to the application layer with the characteristic low CPU/low latency of the Myricom MVA solution.

Comparable accuracy is achieved to IEEE1588 based solutions using these methods. The benefits of this implementation are the elimination of the network switch resident in high accuracy systems. Typically, in these cases, one camera would serve time to the other cameras through the switch while the PCs would be there simply to process the frames. For ultra high speed 10G applications, the switch can be quite costly and in addition adds another point of failure to systems with strong reliability requirements.

Other benefits of the general solution over external triggering are an elimination of the wires that would run between cameras which pass the triggering information.

In addition, IRIGB is often resident in many systems so it is only a matter of patching the IRIGB signal into the sync NICs with very little added cost.

The solution can use either SFP+ cabling options including fiber for distances >10m and direct attach for distances 10m or less. All cabling options are available through Emergent.

The next section describes in detail the process by which synchronization is achieved.

Implementation

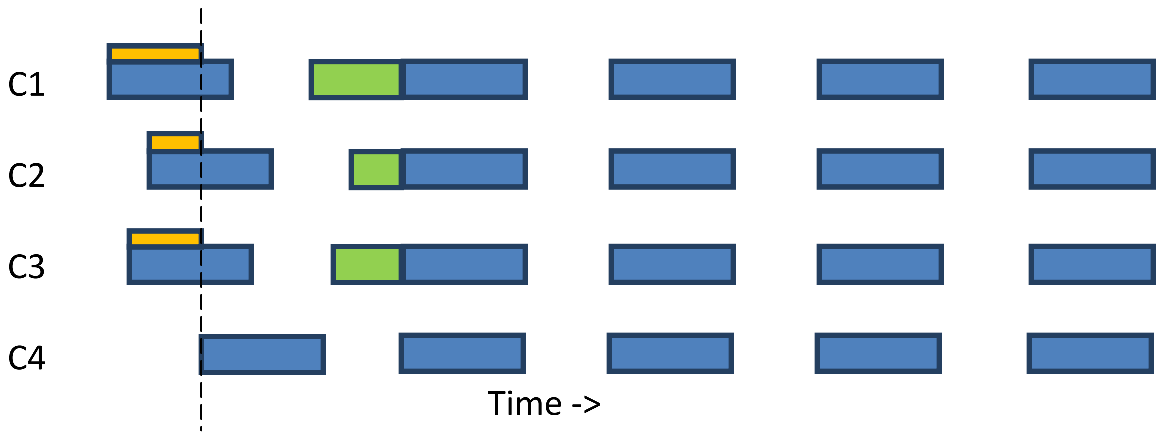
```
//////////////////////
//Grab frame loop in EVT_BenchmarkHS_Sync example.
while (!p_wrk->done)
{
  ….
  err = EVT_CameraQueueFrame(p_cam, &evtFrameRecv);
  …
  err = EVT_CameraGetFrame(p_cam, &evtFrameRecv, EVT_INFINITE);
  …
  synchronize_cameras(p_wrk, &evtFrameRecv);
  …
  //Now can process the frame here as evtFrameRecv has frame data....
}
```

The above example code(from the EVT_BenchmarkHS_Sync eSDK example), simplified for clarity, is run within a software thread with one thread startedfor each camera.

The code queues and gets frames in the standard manner, however, with these frames in hand the associated timestamp field of the frame structure is used within synchronize_cameras() to determine the time offset of each frame which is based on timestamping of the frames as they are received by the Myricom sync NICs. With these time offsets calculated, a suitable time offset correction is written back to the cameras to correct for any time skew with said offsets taking effect immediately on the next frames transmitted by the cameras.

The example starts the cameras grabbing and once the first frames are received by the cameras then the major offsets are calculated and corrected for. From then on, at predetermined intervals, the minor offset calculation and correction is repeated.

The code can be configured to perform this synchronization at various intervals for programmatic control of the synchronization accuracy.



As illustrated above, the blue blocks indicate exposures by the cameras C1-C4. The orange blocks indicate the time that the given camera's exposure is offset from the slowest camera which in this case is camera C4. The synchronization process is about determining these offsets in orange and writing the applicable correctionoffsets to the "early" cameras to delay the start of the next frame by these correction offsets shown in green above.

With the offsets applied, all cameras are now synchronized and thus start their exposures at the same time. This illustration is a larger scale offset correction which may be present when first starting the cameras streaming.

When multiple PCs are involved, a lower bandwidth link between computers such as a standard network can be utilized to pass the timestamp and calculated offset correction information between the master and slave threads which now are running on separate PCs.

Coupled with the various cabling options, the solution is the most flexible, cost and performance optimzed, solution for ultra high speed synchronized camera applications.

Document History

Version	Date	Description
1.01	24Sept 2013	Initial Version