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TECHNICAL INFORMATION

BU Series

Bus Synchronization Mode

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September 16, 2015

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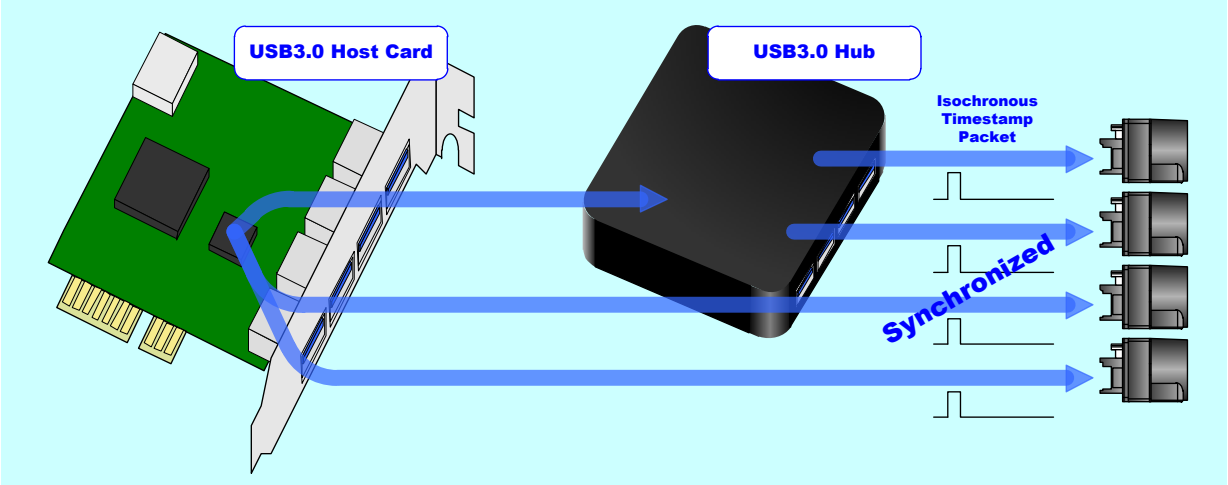
1. Overview

Bus Synchronization mode enables multiple cameras' exposure to be synchronized without using the hardware trigger signal.

In Bus Synchronization mode, cameras are synchronized with periodical 'Isochronous Timestamp Packet (ITP)' of USB bus. Isochronous Timestamp Packet (ITP) is used to deliver timestamps from the host PC to all USB devices. It is multicast by hubs to all of their downstream ports.

This technical information describes operating conditions and considerations of Bus Synchronization mode.

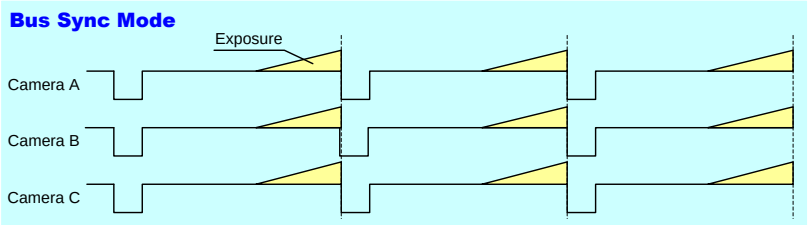


2. Functional Description

2.1. Bus Synchronous mode: FrameSynchronization = Bus

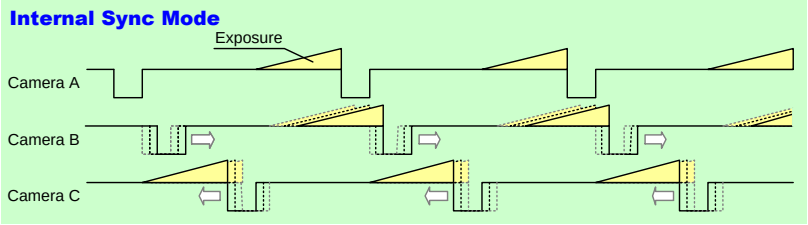
Bus Synchronization mode, utilizing timestamps of USB bus, is a function to synchronize exposure of the multiple cameras connected to the same bus.

It enables multiple cameras' exposure to be synchronized without using the hardware trigger signal.



2.2. Internal Synchronous mode: FrameSynchronization = Off

In Internal Synchronous mode, each camera works with individual timing, exposure is not synchronized.



3. Operating Conditions

3.1. Camera Model

The camera models to be synchronized do not necessarily have to be same.

It is just required to adjust cameras' frame rate to the slowest one.

For example, if you want to synchronize BU030 (MAX125fps) and BU130 (MAX30fps), adjust both cameras' frame rate to less than 30fps.

3.2. Trigger Mode

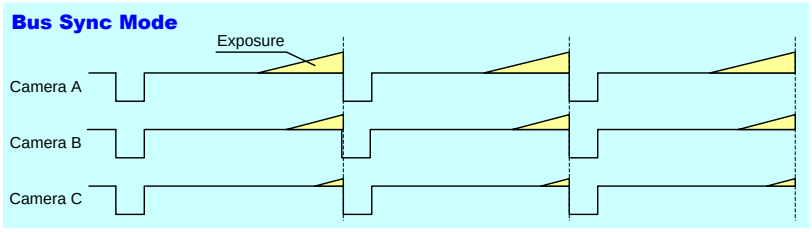
Bus Synchronization mode operates in Normal Shutter mode (TriggerMode = Off).

In Random Trigger Shutter mode, trigger input signal has priority (TriggerMode = On)

3.3. Exposure Time

Exposure time should be shorter than frame rate period.

Each camera can have different exposure time. At this time, the end of exposure is synchronized.



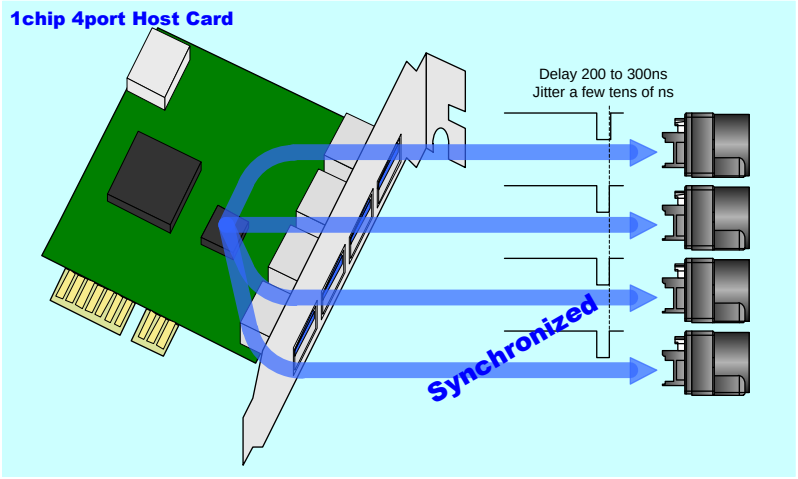
3.4. Bus Topology

3.4.1. Single-host controller card with multiple ports

Cameras connected to different port can be synchronized.

The time difference between each port is about 200 to 300 ns.

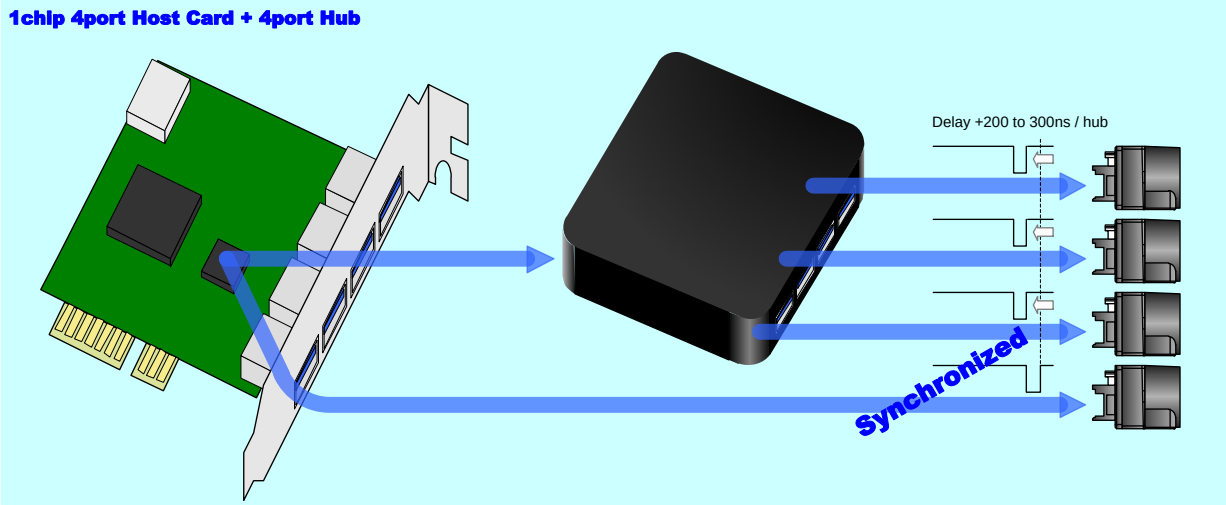
The time jitter is a few tens of ns.



3.4.2. Using Hubs

You can also use the USB Hubs when you want to connect more cameras.

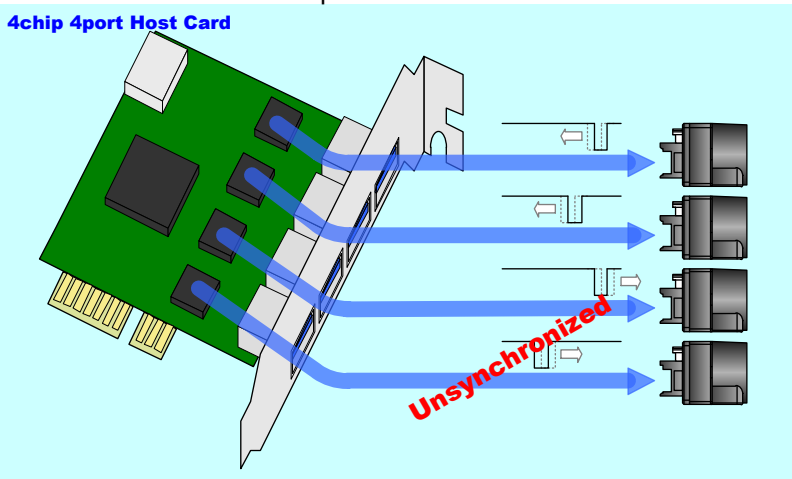
The time delay of the USB Hubs is also about 200 to 300 ns per hub.



3.4.3. Multiple-host controller card (e.g. 4 host x 4 port card)

Cameras connected to different port cannot be synchronized.

Each host has an individual timestamp.



Note:

In Intel's native support USB3.0 Host Controller (any hubs other than the root hub is not interposed), each port has same timestamp.

Cameras connected to different port can be synchronized and achieve 400MByte/s respectively.

For more information, please contact our sales representative.

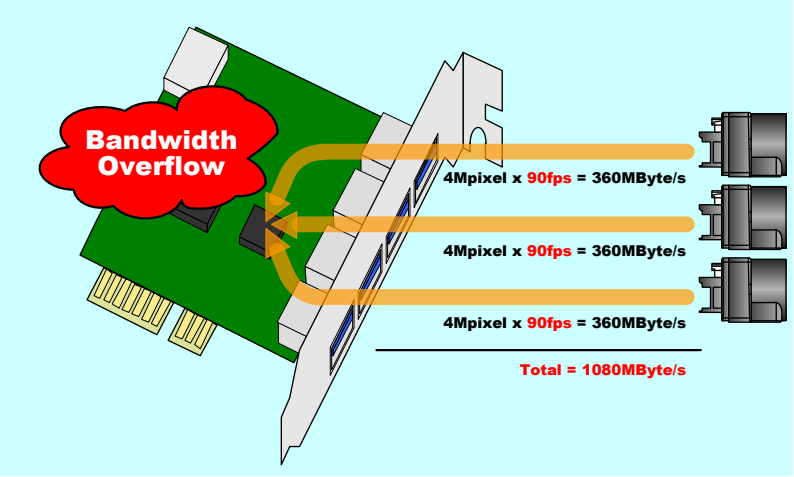
4. Considerations

4.1. Bus Bandwidth

In the end, all cameras are connected to single host controller in Bus Synchronization mode.

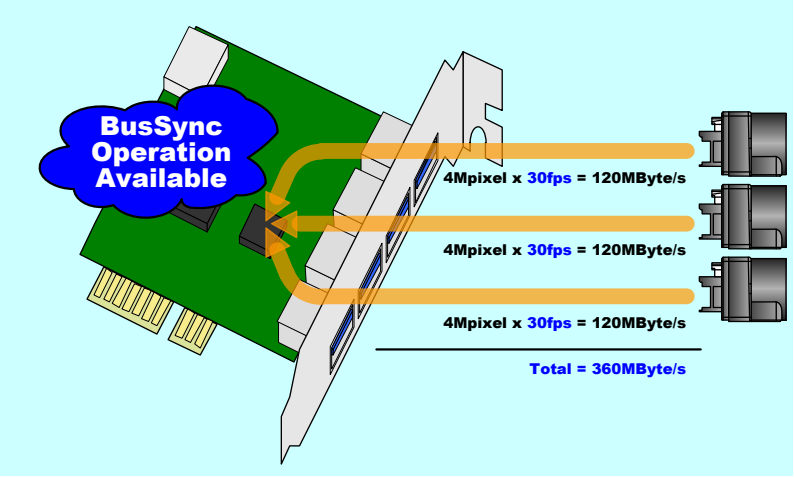
The total bus bandwidth should be controlled less than 400Mbyte/s (depending on the host controller's performance).

For example, if you want to run three BU406M, Bus Synchronization does not work at default 90fps setting because the bus bandwidth overflows (1080Mbyte/s in total).



To solve this bandwidth overflow, the frame rate setting should be lowered to 30fps.

The total required bandwidth will be reduced to 360MByte/s. Then, Bus Synchronization will work.



5. Registers

Register	Address	Access	Description
FrameSynchronization	0x21F03C	R/W	Selects the camera frame synchronization mode. [0]: [Off]: Internal Synchronous mode [1]: [Bus]: Bus Synchronous mode

Table 1. Frame Synchronization Mode Register