

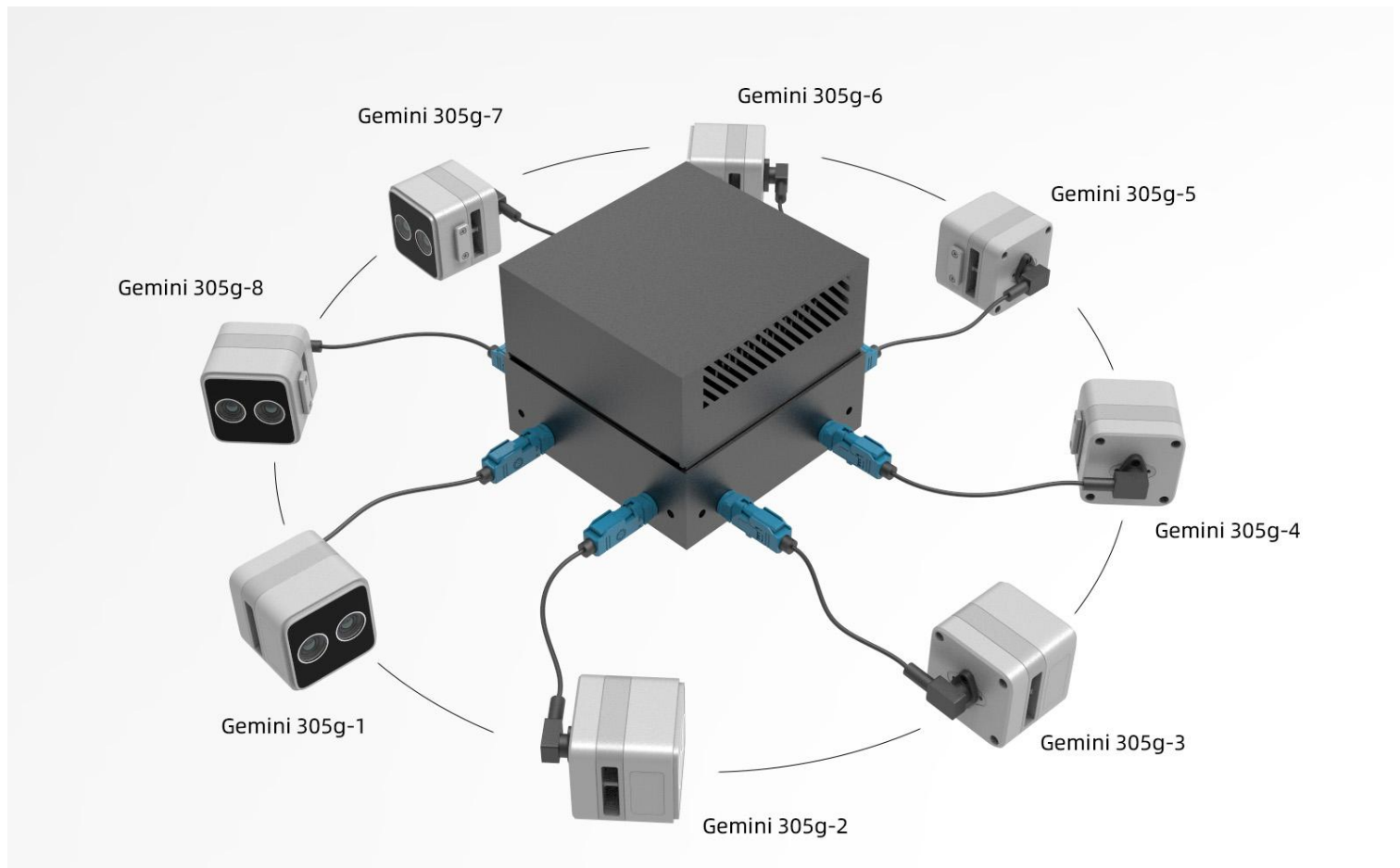
Gemini 305g 多机同步使用说明

一、同步模式说明：

- 1.Secondary-Synced：从机同步模式，相机工作在连续采集状态，机内 RGB - D 同步，且跟随外部硬件同步信号、同步采集图像。支持通过 GMSL 接口接收和发送同步/触发信号。
2. Hardware Triggering：硬件触发模式，相机工作在触发采集状态，在收到外部硬件触发信号后，同步采集 RGB - D 图像。支持单次触发、连续采集多帧，帧数可配。支持通过 GMSL 接口接收和发送同步/触发信号。

二、硬件平台及连接说明图：

1. 硬件实物图（以 AGX Orin 为例）

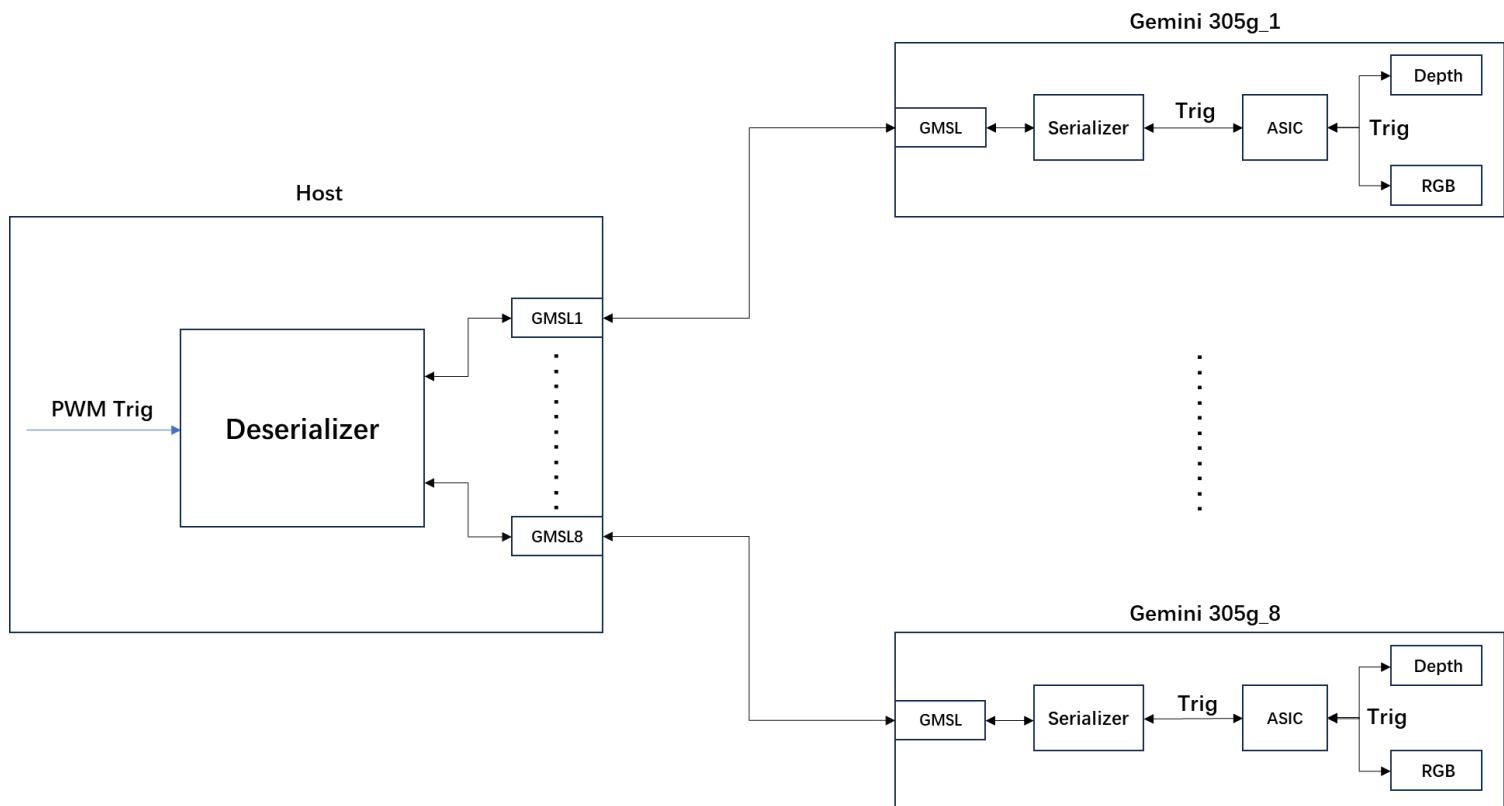


注：图中以 Gemini 305g 为示例，奥比 GMSL 系列传感器的 GMSL 接口的驱动，硬件完全一致，在实际部署的时候支持混用

2. 同步信号链路示意图：

1) 为了实现精准同步，主机应能够输出稳定、高精度的触发信号。在将触发信号输出到支持的解串器 MAX9296A 或其他兼容解串器后，解串器和串行器可以通过同轴电缆通过 GPIO 映射将信号传输到 ASIC，Gemini 305g 串行器使用的 GPIO 为 MFP6

2) 用户可以在奥比官方预览工具 Orbbec Viewer 中评估同步效果。用户可在 Orbbec viewer 中将摄像头#1 至摄像头#8 设置为“Secondary-synced”，然后使用提供的脚本从生成 PWM 信号。此情况下，8 台摄像头都是作为从机使用，以上位机为主机，实现精准的多机同步。在配置完好，无外部干扰情况下，同步精度可达 1ms。



3. GMSL IO 口定义说明:

引脚	I/O	定义	功能描述	解串器优先级
MFP3	O	WAKE	相机进入睡眠模式，高电平唤醒	二级 —— 需低功耗运行时使用
MFP6	O	SYNC_IN	多机同步 SYNC_IN，串行器 IC 输出至 ASIC，高脉冲有效，脉冲宽度 $\geq 1\text{ms}$	二级 —— 需多相机同步运行时使用
MFP7	O	PPS	GPS 秒脉冲信号，高脉冲有效，脉冲宽度 $> 1\text{ms}$	二级 —— 需模块电源复位操作时使用
MFP8	O	RESTART	多机同步 SYNC_OUT，ASIC 输出至串行器 IC，高脉冲有效，脉冲宽度 $\geq 1\text{ms}$	二级 —— 需多相机同步运行时使用
MFP9	I	SYNC_OUT	多机同步 SYNC_OUT，ASIC 输出至串行器 IC，高脉冲有效，脉冲宽度 $\geq 1\text{ms}$	二级 —— 需多相机同步运行时使用
MFP15	O/I	I2C_SDA	I2C_SDA(主)	一级 —— 强制使用
MFP16	O	I2C_SCL	I2C_SCL (主)	一级—— 强制使用

三、平台及配件支持信息

	支持信息	存放链接
硬件平台	AGX Orin, AGX Orin NX, Xavier	
固件版本	1.0.70 及以上	doc.orbbec.com/documentation/Gemini 305 Documentation/Firmware Release of Gemini 305
SDK 版本	Orbbec SDK 2.8.6 及以上	doc.orbbec.com/documentation/Gemini 305 Documentation/Firmware Release of Gemini 305
解串板型号	FG96-8CH-V2; LI-JAG-ADP-GMSL2-8CH	

支持传感器型号	Gemini 335Lg, Gemini 338Lg, Gemini 305g, Gemini 345Lg	
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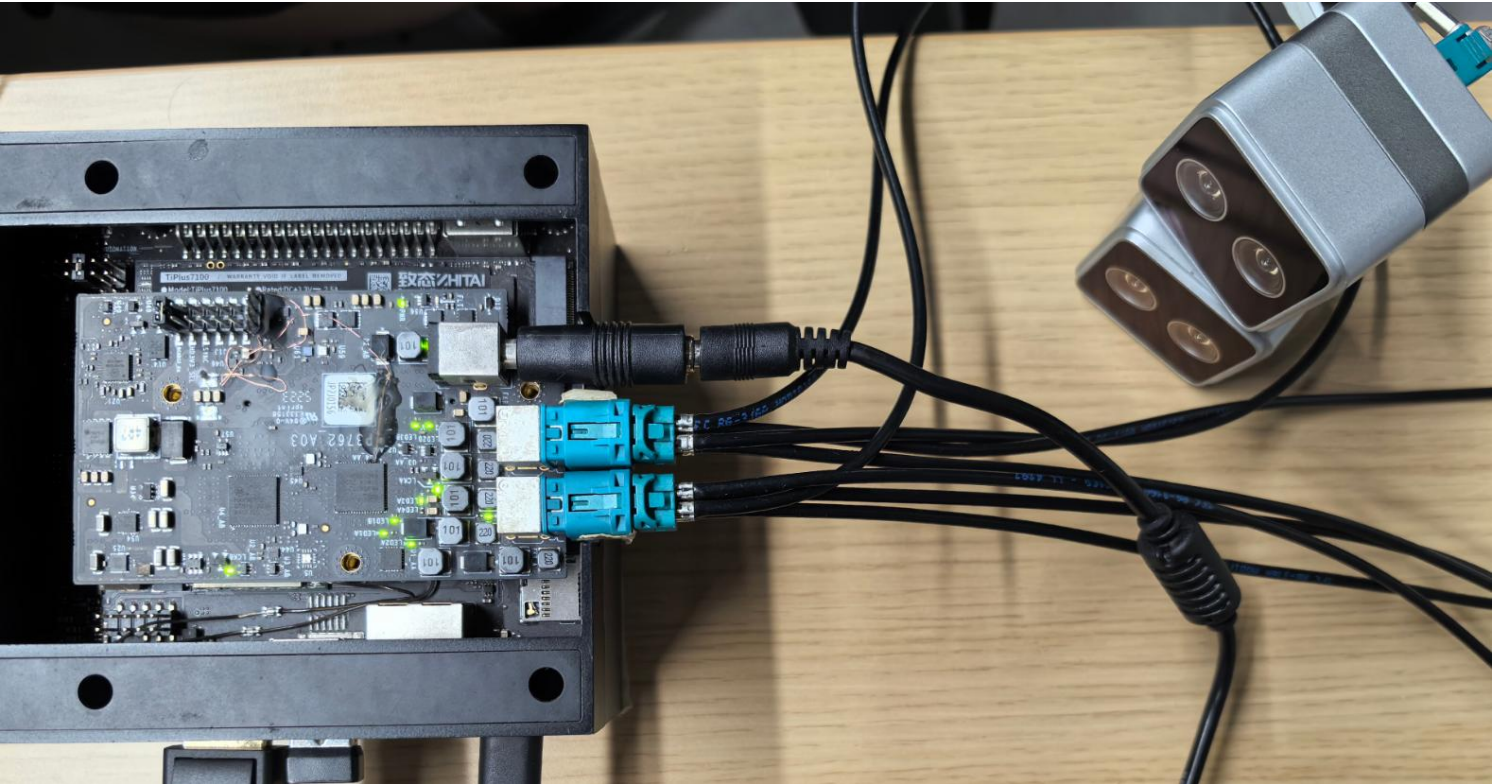
四、同步模式配置示例

1. 示例环境说明

	支持信息	存放链接
硬件平台	AGX Orin	
驱动版本	1.2.16	https://github.com/orbbec/MIPI_Camera_Platform_Driver
固件版本	1.0.70	doc.orbbec.com/documentation/Gemini 305 Documentation/Firmware Release of Gemini 305
测试 SDK	同步测试工具	GitHub - orbbec/Multi-Device-Synchronization-Example at feature/add_multi_device · GitHub
解串板型号	LI-JAG-ADP-GMSL2-8CH	

```
orbbec@ubuntu:~/test/ros/src$ modinfo g300
filename:      /lib/modules/5.15.148-tegra/updates/drivers/media/i2c/g300.ko
version:      1.2.16(JP6.2)
license:      GPL v2
author:       yezhenhao <yanxiao@orbbec.com>
author:       chenwendong <xuanyuan@orbbec.com>
description:  Orbbec G300 Camera Driver
srcversion:   BD1F74BC72130E89FB1CBBE
alias:        of:N*T*Corbbec,g300C*
alias:        of:N*T*Corbbec,g300
alias:        i2c:g300
depends:       obc_max9296,v4l2-async,obc_max96712,videodev,mc,tegra-camera
name:         g300
vermagic:     5.15.148-tegra SMP preempt mod_unload modversions aarch64
sig_id:       PKCS#7
```

2. 实物连接方式:



3. SDK 编译:

```
代码示例验证:
编译:
#cd Multi-Device-Synchronization-Example-feature-add_multi_device
#mkdir build && cd build
#cmake ..
#cmake --build . --config Release
```

五、触发模式说明:

1.Secondary-synced Mode

①工作原理:

- 1) 主设备通过同步信号在每帧曝光时发送硬件触发信号。
- 2) 从设备在接收到触发信号后执行曝光拍摄。

②启动顺序:

- 1) 先启动所有从设备
- 2) 然后执行硬件触发信号

③硬件触发信号要求:

- 1) 触发信号电气要求

VSYNC_IN	输入驱动电平: =VCC 电压
	输入有效电平: VIH: VCC×0.65, VIL: ≤0.7V
	输入驱动电流: 1.8V~5.0V 电平≥4 mA, 可根据实际场景线长适当加大驱动电流
	信号上升率: 1.8V 电平≤30ns/V, 3.3V 电平≤20ns/V, 5.0V 电平≤8ns/V
	信号下降率: 1.8V 电平≤90ns/V, 3.3V 电平≤90ns/V, 5.0V 电平≤50ns/V
	信号触发方式: 上升沿触发; 调整信号要求: 单脉冲触发

- 2) 触发信号波动要求:
30 fps : 33.453ms (29.892HZ) ~ 33.333ms (30HZ, 不包括 30HZ)

④配置示例:

- 1) 在 Multi-Device-Synchronization-Example-feature-add_multi_device/config 里, 配置 MultiDeviceSyncConfig.json 文件:

```
"version": "1.0.1",
"configTime": "2023/01/01",
"devices": [
  {
    "sn": "CV34361000EW",
    "syncConfig": {
      "syncMode": "OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED",
      "depthDelayUs": 0,
      "colorDelayUs": 0,
      "trigger2ImageDelayUs": 0,
      "triggerOutEnable": true,
      "triggerOutDelayUs": 0,
      "framesPerTrigger": 1
    }
  },
  {
    "sn": "CV34361000E6",
    "syncConfig": {
      "syncMode": "OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED",
      "depthDelayUs": 0,
      "colorDelayUs": 0,
      "trigger2ImageDelayUs": 0,
      "triggerOutEnable": true,
      "triggerOutDelayUs": 0,
      "framesPerTrigger": 1
    }
  }
]
```

2) 配置参数说明:

领域	描述
syncMode	同步模式。可用值: OB_MULTI_DEVICE_SYNC_MODE_PRIMARY , OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED , OB_MULTI_DEVICE_SYNC_MODE_SOFTWARE_TRIGGERING , OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING
depthDelayUs	配置深度触发延迟, 单位: 微秒
colorDelayUs	颜色触发信号输入延迟, 以微秒为单位。通常设置为0
trigger2ImageDelayUs	从触发信号输入到图像捕获的延迟, 以微秒为单位。通常设置为0
triggerOutEnable	设备触发信号输出使能开关
triggerOutDelayUs	设备触发信号输出延迟以微秒为单位。通常设置为0
framesPerTrigger	每个触发捕获的帧数。仅在软件触发和硬件触发模式下有效, 通常设置为1

进入到 build/bin 目录下: 运行./MultiDeviceSync

```
orbbe@ubuntu:~/test/Multi-Device-Synchronization-Example-feature-add_multi_device/build/bin$ ./MultiDeviceSync
-----
Please select options:
0 --> config devices sync mode.
1 --> start stream
-----
Please select input: 0

config[0]: SN=CV34361000EW, mode=OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED
config[1]: SN=CV34361000E6, mode=OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED
-Config Device syncMode:16, syncModeStr:OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED
-Config Device syncMode:16, syncModeStr:OB_MULTI_DEVICE_SYNC_MODE_SECONDARY_SYNCED
Config MultiDeviceSync Success.

Secondary devices start...
startStream: CV34361000EW sensorType:3
startStream: CV34361000EW sensorType:2
startStream: CV34361000E6 sensorType:3
startStream: CV34361000E6 sensorType:2
WARNING primary_devices is empty!!!

Device#0, depth(us) , frame timestamp=1779694971281968,global timestamp = 1779694971285690,system timestamp = 1779694971312985
Device#0, color(us) , frame timestamp=1779694971281963,global timestamp = 1779694971285685,system timestamp = 1779694971312917
Device#1, depth(us) , frame timestamp=1779694971291247,global timestamp = 1779694971294494,system timestamp = 1779694971321219
Device#1, color(us) , frame timestamp=1779694971291242,global timestamp = 1779694971294489,system timestamp = 1779694971319774
-----
Device#0, depth(us) , frame timestamp=1779694971315276,global timestamp = 1779694971318988,system timestamp = 1779694971346291
Device#0, color(us) , frame timestamp=1779694971315272,global timestamp = 1779694971318984,system timestamp = 1779694971346510
Device#1, depth(us) , frame timestamp=1779694971324556,global timestamp = 1779694971327786,system timestamp = 1779694971354503
Device#1, color(us) , frame timestamp=1779694971324551,global timestamp = 1779694971327781,system timestamp = 1779694971353086
-----
Device#0, depth(us) , frame timestamp=1779694971348585,global timestamp = 1779694971352287,system timestamp = 1779694971379584
Device#0, color(us) , frame timestamp=1779694971348580,global timestamp = 1779694971352282,system timestamp = 1779694971379454
Device#1, depth(us) , frame timestamp=1779694971357864,global timestamp = 1779694971361077,system timestamp = 1779694971390177
-----
Device#1, depth(us) , frame timestamp=1779694811712409,global timestamp = 1779694811721401,system timestamp = 1779694811742545
Device#1, color(us) , frame timestamp=1779694811712404,global timestamp = 1779694811721396,system timestamp = 1779694811741353
-----
Device#0, depth(us) , frame timestamp=1779694811735512,global timestamp = 1779694811745197,system timestamp = 1779694811772272
Device#0, color(us) , frame timestamp=1779694811735508,global timestamp = 1779694811745193,system timestamp = 1779694811771414
Device#1, depth(us) , frame timestamp=1779694811745717,global timestamp = 1779694811749522,system timestamp = 1779694811775965
Device#1, color(us) , frame timestamp=1779694811745712,global timestamp = 1779694811749517,system timestamp = 1779694811775965
-----
Device#0, depth(us) , frame timestamp=1779694811770469,global timestamp = 1779694811770469,system timestamp = 1779694811770469
Device#0, color(us) , frame timestamp=1779694811770465,global timestamp = 1779694811770465,system timestamp = 1779694811770465
Device#1, depth(us) , frame timestamp=1779694811779026,global timestamp = 1779694811779026,system timestamp = 1779694811779026
Device#1, color(us) , frame timestamp=1779694811779021,global timestamp = 1779694811779021,system timestamp = 1779694811779021
-----
Device#0, depth(us) , frame timestamp=1779694811803778,global timestamp = 1779694811803778,system timestamp = 1779694811803778
Device#0, color(us) , frame timestamp=1779694811803773,global timestamp = 1779694811803773,system timestamp = 1779694811803773
Device#1, depth(us) , frame timestamp=1779694811812334,global timestamp = 1779694811812334,system timestamp = 1779694811812334
Device#1, color(us) , frame timestamp=1779694811812330,global timestamp = 1779694811812330,system timestamp = 1779694811812330
-----
Device#0, depth(us) , frame timestamp=1779694811842024,global timestamp = 1779694811842024,system timestamp = 1779694811842024
Device#0, color(us) , frame timestamp=1779694811842019,global timestamp = 1779694811842019,system timestamp = 1779694811842019
Device#1, depth(us) , frame timestamp=1779694811845643,global timestamp = 1779694811845643,system timestamp = 1779694811845643
Device#1, color(us) , frame timestamp=1779694811845638,global timestamp = 1779694811845638,system timestamp = 1779694811845638
-----
Device#0, depth(us) , frame timestamp=1779694811875332,global timestamp = 1779694811875332,system timestamp = 1779694811875332
Device#0, color(us) , frame timestamp=1779694811875328,global timestamp = 1779694811875328,system timestamp = 1779694811875328
Device#1, depth(us) , frame timestamp=1779694811878952,global timestamp = 1779694811878952,system timestamp = 1779694811878952
Device#1, color(us) , frame timestamp=1779694811878947,global timestamp = 1779694811878947,system timestamp = 1779694811878947
-----
Device#0, depth(us) , frame timestamp=1779694811908641,global timestamp = 1779694811908641,system timestamp = 1779694811908641
Device#0, color(us) , frame timestamp=1779694811908636,global timestamp = 1779694811908636,system timestamp = 1779694811908636
Device#1, depth(us) , frame timestamp=1779694811912260,global timestamp = 1779694811912260,system timestamp = 1779694811912260
Device#1, color(us) , frame timestamp=1779694811912255,global timestamp = 1779694811912255,system timestamp = 1779694811912255
-----
Device#0, depth(us) , frame timestamp=1779694811941950,global timestamp = 1779694811941950,system timestamp = 1779694811941950
Device#0, color(us) , frame timestamp=1779694811941945,global timestamp = 1779694811941945,system timestamp = 1779694811941945
Device#1, depth(us) , frame timestamp=1779694811945569,global timestamp = 1779694811945569,system timestamp = 1779694811945569
Device#1, color(us) , frame timestamp=1779694811945564,global timestamp = 1779694811945564,system timestamp = 1779694811945564
-----
Device#0, depth(us) , frame timestamp=1779694811975258,global timestamp = 1779694811975258,system timestamp = 1779694811975258
Device#0, color(us) , frame timestamp=1779694811975254,global timestamp = 1779694811975254,system timestamp = 1779694811975254
Device#1, depth(us) , frame timestamp=1779694811978877,global timestamp = 1779694811978877,system timestamp = 1779694811978877
Device#1, color(us) , frame timestamp=1779694811978873,global timestamp = 1779694811978873,system timestamp = 1779694811978873
-----
Device#0, depth(us) , frame timestamp=1779694811998567,global timestamp = 1779694811998567,system timestamp = 1779694811998567
Device#0, color(us) , frame timestamp=1779694811998563,global timestamp = 1779694811998563,system timestamp = 1779694811998563
Device#1, depth(us) , frame timestamp=1779694812002264,global timestamp = 1779694812002264,system timestamp = 1779694812002264
Device#1, color(us) , frame timestamp=1779694812002260,global timestamp = 1779694812002260,system timestamp = 1779694812002260
-----
Device#0, depth(us) , frame timestamp=1779694812028776,global timestamp = 1779694812028776,system timestamp = 1779694812028776
Device#0, color(us) , frame timestamp=1779694812028772,global timestamp = 1779694812028772,system timestamp = 1779694812028772
Device#1, depth(us) , frame timestamp=1779694812032473,global timestamp = 1779694812032473,system timestamp = 1779694812032473
Device#1, color(us) , frame timestamp=1779694812032469,global timestamp = 1779694812032469,system timestamp = 1779694812032469
-----
```

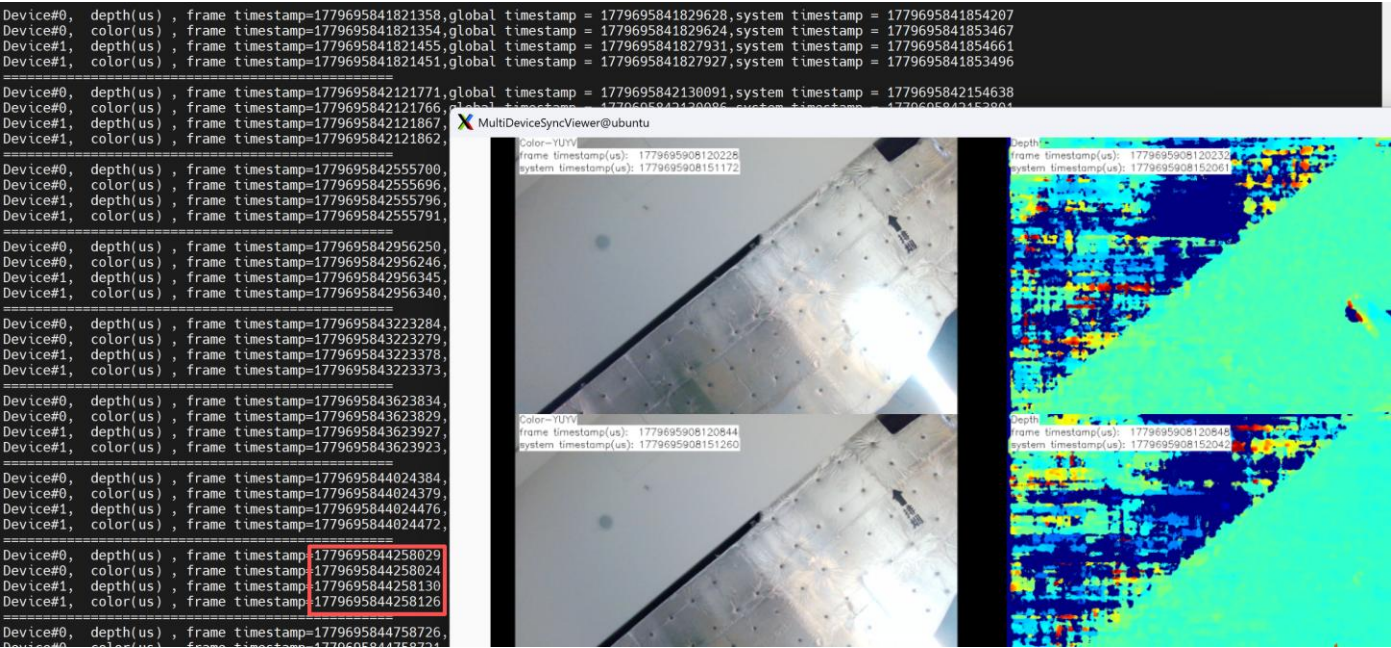
没启动硬件触发信号前，时间戳会有个 3ms 左右的误差，
管理员权限执行：sudo ./MultiDeviceSyncGmslTrigger

```
orbbe@ubuntu:~/test/Multi-Device-Synchronization-Example-feature-add_multi_device/build/bin$ sudo ./MultiDeviceSyncGmslTrigger
[sudo] password for orbbe:
Please select options:
-----
0 --> config GMSL SOC PWM trigger Source. Set trigger fps:
1 --> start Trigger
2 --> stop Trigger
3 --> exit
-----
input select item: 0

Enter FPS (frames per second) (for example: 3000): 3000
Setting FPS to 3000...
Please select options:
-----
0 --> config GMSL SOC PWM trigger Source. Set trigger fps:
1 --> start Trigger
2 --> stop Trigger
3 --> exit
-----
input select item: 1

write param: mode=1, fps=3000
read param: mode=1, fps=3000
start pwm source TriggerSync...
```

执行后，时间戳同步结果：



2.HARDWARE_TRIGGERING Mode

- ① 工作原理：硬件触发模式。设备在通过同步端口接收到外部硬件触发信号时捕获指定数量的帧。
- ② 硬件触发信号要求：

VSYNC_IN	输入驱动电平：=VCC 电压
	输入有效电平：VIH：VCC×0.65，VIL：≤0.7V
	输入驱动电流：1.8V~5.0V 电平≥4 mA，可根据实际场景线线长适当加大驱动电流
	信号上升率：1.8V 电平≤30ns/V，3.3V 电平≤20ns/V，5.0V 电平≤8ns/V
	信号下降率：1.8V 电平≤90ns/V，3.3V 电平≤90ns/V，5.0V 电平≤50ns/V
	信号触发方式：上升沿触发；调整信号要求：单脉冲触发

- ③启动顺序：
 - 1) 该设备配置为硬件触发模式。
 - 2) 该设备通过同步端口接收硬件触发信号
 - 3) 每个触发器捕获 framesPerTrigger 帧
 - 4) 该设备通过同步端口同时输出触发信号（默认启用），该信号可用于链式触发下一个设备。

④触发频率限制：
为了确保在此模式下正常运行，必须将 IR、深度和 RGB 传感器配置为相同的固定帧率（例如，5、10、15、30 或 60 fps）。此设置确定了两次触发之间允许的最短时间，从而决定了最大有效触发频率。相机只会响应在此允许范围内的时间触发信号。因此，任何在有效范围内的触发频率都可以被动支持。

Set The Camera's Fixed Frame Rate(fps)	Supportable Passive Trigger Interval (ms)	Supportable Passive Trigger Frequency (Hz)
60	≥33.4	0-30
30	≥33.4	0-30
15	≥66.7	0-15
10	≥133.4	0-10

⑤配置示例:

修改 MultiDeviceSyncConfig.json:

```
{
  "version": "1.0.1",
  "configTime": "2023/01/01",
  "devices": [
    {
      "sn": "CV34361000EW",
      "syncConfig": {
        "syncMode": "OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING",
        "depthDelayUs": 0,
        "colorDelayUs": 0,
        "trigger2ImageDelayUs": 0,
        "triggerOutEnable": true,
        "triggerOutDelayUs": 0,
        "framesPerTrigger": 1
      }
    },
    {
      "sn": "CV34361000E6",
      "syncConfig": {
        "syncMode": "OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING",
        "depthDelayUs": 0,
        "colorDelayUs": 0,
        "trigger2ImageDelayUs": 0,
        "triggerOutEnable": true,
        "triggerOutDelayUs": 0,
        "framesPerTrigger": 1
      }
    }
  ]
}
```

1) 打开第一个终端并运行多设备同步示例:

```
orrbec@ubuntu:~/test/Multi-Device-Synchronization-Example-feature-add_multi_device/build/bin$ ./MultiDeviceSync
```

```
-----
Please select options:
0 --> config devices sync mode.
1 --> start stream
-----
Please select input: 0

config[0]: SN=CV34361000EW, mode=OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING
config[1]: SN=CV34361000E6, mode=OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING
-Config Device syncMode:64, syncModeStr:OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING
-Config Device syncMode:64, syncModeStr:OB_MULTI_DEVICE_SYNC_MODE_HARDWARE_TRIGGERING
Config MultiDeviceSync Success.

Secondary devices start...
startStream: CV34361000EW sensorType:3
startStream: CV34361000EW sensorType:2
startStream: CV34361000E6 sensorType:3
startStream: CV34361000E6 sensorType:2
WARNING primary_devices is empty!!!
```

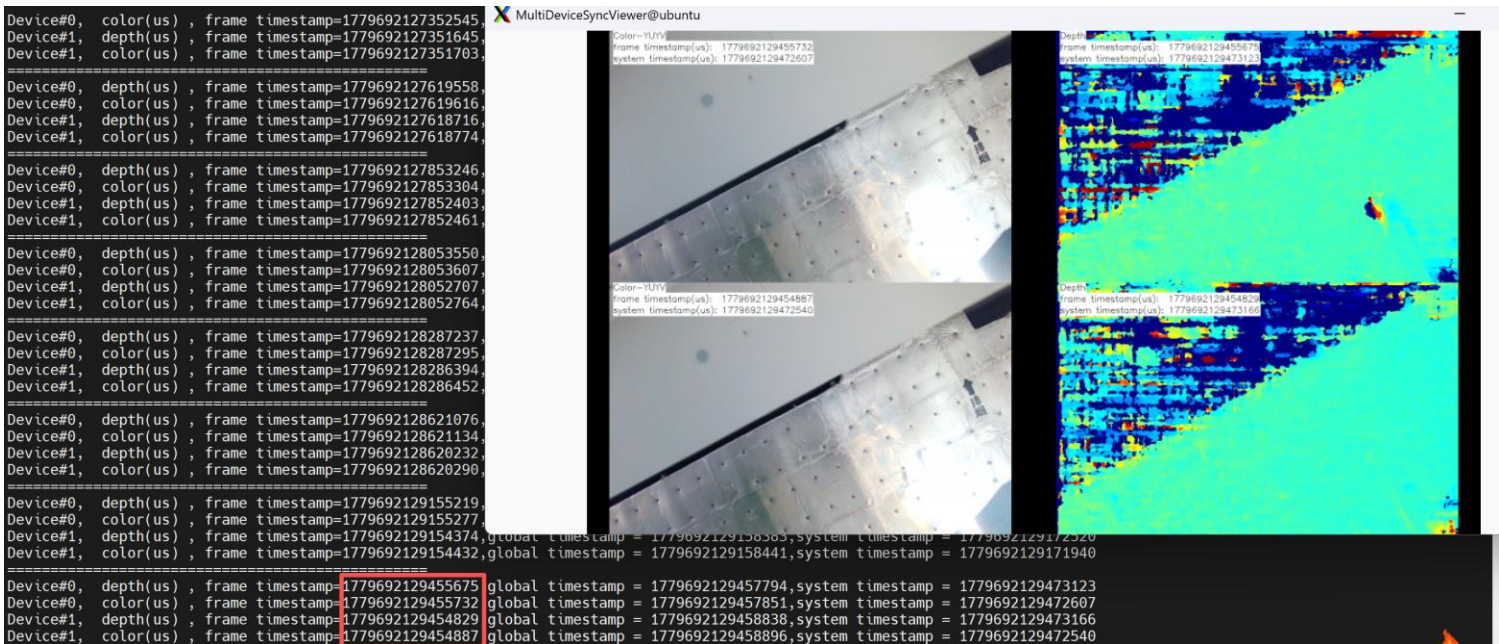
```
MultiDeviceSyncViewer@ubuntu
```

```
Waiting for streams...
```

2) 打开第二个终端并以管理员权限运行发送 PWM 触发信号的示例

```
orbbec@ubuntu:~/test/Multi-Device-Synchronization-Example-feature-add_multi_device/build/bin$ sudo ./MultiDeviceSyncGmslTrigger
[sudo] password for orbbec:
Please select options:
-----
0 --> config GMSL SOC PWM trigger Source. Set trigger fps:
1 --> start Trigger
2 --> stop Trigger
3 --> exit
-----
input select item: 0
-----
Enter FPS (frames per second) (for example: 3000): 3000
Setting FPS to 3000...
Please select options:
-----
0 --> config GMSL SOC PWM trigger Source. Set trigger fps:
1 --> start Trigger
2 --> stop Trigger
3 --> exit
-----
input select item: 1
-----
write param: mode=1, fps=3000
read param: mode=1, fps=3000
start pwm source TriggerSync...
Please select options:
-----
0 --> config GMSL SOC PWM trigger Source. Set trigger fps:
1 --> start Trigger
2 --> stop Trigger
3 --> exit
-----
input select item: 1
```

3) 测试结果:



附：

ROS2 运行示例：

2*335LG + 2*305G

GMSL 多机文档参考链接：

[5.2.4. GMSL 相机 — OrbbecSDK V2 ROS2 封装 文档](#)

ros2 sdk version : 2.8.6

确保 **camsync** 权限： `chmod 777 /dev/camsync`

在/orbbec_camera/examples/gmsl_camera下的multi_gmsl_camera_synced.launch.py配置：

```
launch1_include = IncludeLaunchDescription(
    PythonLaunchDescriptionSource(
        os.path.join(launch_file_dir, "gemini_330_gmsl.launch.py")
    ),
    launch_arguments={
        "camera_name": "camera_01",
        "usb_port": "gmsl2-0",
        "device_num": "4",
        "sync_mode": "hardware_triggering",
        "gmsl_trigger_fps": "3000",
        "enable_gmsl_trigger": "true",
        "config_file_path": secondary_config_file_path,
        "attach_to_shared_component_container": attach_to_shared_component_container_arg,
        "component_container_name": component_container_name_arg,
    }.items(),
)

launch2_include = IncludeLaunchDescription(
    PythonLaunchDescriptionSource(
        os.path.join(launch_file_dir, "gemini_330_gmsl.launch.py")
    ),
    launch_arguments={
        "camera_name": "camera_02",
        "usb_port": "gmsl2-1",
        "device_num": "4",
        "sync_mode": "hardware_triggering",
        "config_file_path": secondary_config_file_path,
        "attach_to_shared_component_container": attach_to_shared_component_container_arg,
        "component_container_name": component_container_name_arg,
    }.items(),
)

launch3_include = IncludeLaunchDescription(
    PythonLaunchDescriptionSource(
        os.path.join(launch_file_dir, "gemini_330_gmsl.launch.py")
    ),
    launch_arguments={
        "camera_name": "camera_03",
        "usb_port": "gmsl2-2",
```

启动对应 launch：

#ros2 launch orbbec_camera multi_gmsl_camera_synced.launch.py

```
[component_container_mt-1] [INFO] [1781077077.225260078] [camera_01.camera_01]: Set depth filter SpatialModerateFilter to disabled
[component_container_mt-1] [INFO] [1781077077.225287278] [camera_01.camera_01]: Set depth filter SpatialAdvancedFilter to disabled
[component_container_mt-1] [INFO] [1781077077.225313357] [camera_01.camera_01]: Set depth filter TemporalFilter to disabled
[component_container_mt-1] [INFO] [1781077077.225339373] [camera_01.camera_01]: Set depth filter HoleFillingFilter to disabled
[component_container_mt-1] [INFO] [1781077077.225462859] [camera_01.camera_01]: Set depth filter DisparityTransform to enabled
[component_container_mt-1] [INFO] [1781077077.228554839] [camera_01.camera_01]: Set color filter DecimationFilter to disabled
[component_container_mt-1] [INFO] [1781077077.328517759] [camera_01.camera_01]: Publish diagnostics every 1 seconds
[component_container_mt-1] [INFO] [1781077077.610480936] [camera_02.camera_02]: current interleave ae mode : laser
[component_container_mt-1] [INFO] [1781077077.619160182] [camera_02.camera_02]: Enable enable_interleave_depth_frame to false
[component_container_mt-1] [INFO] [1781077077.619268116] [camera_02.camera_02]: Initialize device cost: 9236 ms
[component_container_mt-1] [INFO] [1781077077.663612391] [camera_01.camera_01]: Device Orbbec Gemini 335Lg connected
[component_container_mt-1] [INFO] [1781077077.663685222] [camera_01.camera_01]: Serial number: CPBG1520004A
[component_container_mt-1] [INFO] [1781077077.663714694] [camera_01.camera_01]: Firmware version: 1.7.28.2
[component_container_mt-1] [INFO] [1781077077.663734501] [camera_01.camera_01]: ROS Wrapper version: 2.8.6
[component_container_mt-1] [INFO] [1781077077.663753701] [camera_01.camera_01]: SDK version: 2.8.6
[component_container_mt-1] [INFO] [1781077077.663768869] [camera_01.camera_01]: Hardware version: 0.1
[component_container_mt-1] [INFO] [1781077077.663788452] [camera_01.camera_01]: ISP firmware version: 20260424
[component_container_mt-1] [INFO] [1781077077.663804068] [camera_01.camera_01]: ISP needed version: 20250930
[component_container_mt-1] [INFO] [1781077077.663819300] [camera_01.camera_01]: usb connect type: GMSL2
[component_container_mt-1] [INFO] [1781077077.663832900] [camera_01.camera_01]: device unique id: gmsl2-0
[component_container_mt-1] [INFO] [1781077077.663850755] [camera_01.camera_01]: Current node pid: 282562
[component_container_mt-1] [INFO] [1781077079.618284933] [camera_01.camera_01]: Enable frame sync
[component_container_mt-1] [INFO] [1781077080.618575984] [camera_01.camera_01]: current interleave ae mode : laser
[component_container_mt-1] [INFO] [1781077080.631517205] [camera_01.camera_01]: Enable enable_interleave_depth_frame to false
[component_container_mt-1] [INFO] [1781077080.631637363] [camera_01.camera_01]: Initialize device cost: 6605 ms
[component_container_mt-1] [WARN] [1781077080.631688370] [camera_01.camera_01]: Start HardwareTrigger by soc-trigger-source. gmsl_trigger_fps : 3000
[component_container_mt-1] [INFO] [1781077082.127126901] [camera_01.camera_01]: Set depth AE ROI to 0, 847, 0, 479
[component_container_mt-1] [INFO] [1781077082.127891592] [camera_01.camera_01]: depth Frame - Width: 848 Height: 480 fps: 30 Format: Y16
[component_container_mt-1] [INFO] [1781077082.180861514] [camera_04.camera_04]: Set depth AE ROI to 0, 847, 0, 479
[component_container_mt-1] [INFO] [1781077082.181234948] [camera_04.camera_04]: depth Frame - Width: 848 Height: 480 fps: 30 Format: Y16
[component_container_mt-1] [INFO] [1781077082.195235352] [camera_02.camera_02]: Set depth AE ROI to 0, 847, 0, 529
[component_container_mt-1] [INFO] [1781077082.196373348] [camera_02.camera_02]: depth Frame - Width: 848 Height: 530 fps: 30 Format: Y16
[component_container_mt-1] [WARN] [1781077082.197623663] [camera_02.camera_02]: Skip setting color AE ROI because AE Reference Stream is dep
th
[component_container_mt-1] [INFO] [1781077082.198055688] [camera_02.camera_02]: color Frame - Width: 848 Height: 530 fps: 30 Format: YUYV
[component_container_mt-1] [INFO] [1781077082.2053115021] [camera_03.camera_03]: Set depth AE ROI to 0, 847, 0, 529
[component_container_mt-1] [INFO] [1781077082.205638600] [camera_03.camera_03]: depth Frame - Width: 848 Height: 530 fps: 30 Format: Y16
[component_container_mt-1] [INFO] [1781077082.206591128] [camera_03.camera_03]: color Frame - Width: 848 Height: 530 fps: 30 Format: YUYV
[component_container_mt-1] [INFO] [1781077082.225384315] [camera_01.camera_01]: Set color AE ROI to 0, 1279, 0, 719
[component_container_mt-1] [INFO] [1781077082.225579703] [camera_01.camera_01]: color Frame - Width: 1280 Height: 720 fps: 30 Format: YUYV
[component_container_mt-1] [INFO] [1781077082.250037434] [camera_04.camera_04]: Set color AE ROI to 0, 1279, 0, 719
[component_container_mt-1] [INFO] [1781077082.250255447] [camera_04.camera_04]: color Frame - Width: 1280 Height: 720 fps: 30 Format: YUYV
```

运行#ros2 run orbbec_camera image_sync_example_node 查看同步的效果

```
orbbec@ubuntu:~/test/ros$ ros2 run orbbec_camera image_sync_example_node
[INFO] [1781077482.654312949] [image_sync_node]: image sync node started.
=====
Camera01 stamp: color= 1781077482.698824 depth= 1781077482.700387 Delay relative to camera01(color): color= 0.000 ms depth= 1.563 ms
Camera02 stamp: color= 1781077482.694322 depth= 1781077482.694264 Delay relative to camera01(color): color= -4.502 ms depth= -4.560 ms
Camera03 stamp: color= 1781077482.694835 depth= 1781077482.694835 Delay relative to camera01(color): color= -3.989 ms depth= -3.989 ms
Camera04 stamp: color= 1781077482.700750 depth= 1781077482.700842 Delay relative to camera01(color): color= 1.926 ms depth= 2.018 ms

Image Timestamp Difference Statistics
cur: 4.560 ms avg: 4.560 ms max: 4.560 ms min: 4.560 ms
=====
Camera01 stamp: color= 1781077482.732208 depth= 1781077482.733770 Delay relative to camera01(color): color= 0.000 ms depth= 1.562 ms
Camera02 stamp: color= 1781077482.727705 depth= 1781077482.727647 Delay relative to camera01(color): color= -4.503 ms depth= -4.561 ms
Camera03 stamp: color= 1781077482.728218 depth= 1781077482.728218 Delay relative to camera01(color): color= -3.990 ms depth= -3.990 ms
Camera04 stamp: color= 1781077482.734133 depth= 1781077482.734225 Delay relative to camera01(color): color= 1.925 ms depth= 2.017 ms

Image Timestamp Difference Statistics
cur: 4.561 ms avg: 4.560 ms max: 4.561 ms min: 4.560 ms
```