

GPS receiver Mobile mode operation

Section 1: Introduction

Starting with Tsync-PCIe firmware Release version 2.0.0, all Tsync-PCIe timing boards that contain an internal GPS receiver have the capability of operating in either the factory default “Standard” mode (Also known as the “Stationary” mode) or can instead be programmed to operate in the available “Mobile” mode (also known as “Continuous” mode). While configured to operate in the default Stationary mode, the GPS receiver calculates and locks-in its current location. While configured to operate in the Mobile mode, the GPS receiver will continuously re-acquire its position and keep accurate time while it is in motion.

The Spectracom Tsync-PCIe bus-level timing board may contain an internal GPS receiver as its reference. In general, GPS receivers are either “positional” receivers that are designed to provide very accurate positional information, or they are “timing” receivers that are designed to provide very accurate timing information, instead. The GPS receivers used with the Tsync-PCIe timing boards are “timing” receivers. GPS “timing” receivers provide their most accurate timing outputs when they are used in a stationary environment, where the latitude and longitude can be calculated and locked-in, alleviating the GPS receiver’s need to continuously calculate its current position. For this reason, the GPS receivers in the Tsync-PCIe boards are programmed at the factory to be used in a Stationary mode of operation.

However, the GPS receivers can be reconfigured by a user to operate in a mobile environment (such as in an airplane, onboard a ship or in an automobile, etc). In order for the Tsync-PCIe timing board to have the commands necessary to enable the Mobile mode of operation, the firmware in the Tsync-PCI timing board as well as its associated Linux, Windows or Solaris driver need to be updated in order to support the GPS receiver’s Mobile mode configuration commands. This document discusses how to update the Tsync-PCIe board’s firmware and its associated driver as well as how to program the Tsync-PCIe timing boards for mobile operation.

Note about Mobile Mode: As a general “rule of thumb”, a Tsync-PCIe boards that are operating in Mobile Mode will have its timing performance degraded by at least 3x when compared with a stationary Tsync-PCIe board operating in the Standard (Stationary) Mode.

Applying the Mobile mode operation to an existing Tsync-PCIe timing board

Applying the mobile mode operation to an existing Tsync-PCIe timing board is a three-step process:

- 1) Update the Tsync-PCIe firmware (as described in Section 2 of this document).
- 2) Update the installed Tsync-PCIe driver (as described in Section 3 of this document).
- 3) Using the new driver, configure the Tsync board for Mobile mode and configure the desired Dynamics code (as described in Section 4 of this document).

Section 2: Updating the Tsync-PCIe Timing board firmware

The firmware in the Tsync-PCIe-PCIe board first needs to be updated, in order to support the Mobile mode. The firmware can be updated in the field to allow Mobile mode operation. The Tsync-PCIe firmware needs to be updated prior to updating the driver. This section discusses how to update the firmware.

Procedure to upgrade the Tsync-PCIe-PCIe firmware:

Note: Please update your firmware with your currently installed driver. After the firmware has been upgraded, install the new driver.

Proceed as follows:

- 1) Open a terminal or command prompt.
- 2) Change to the directory in which the driver was installed.
- 3) Change to the upgrade directory:

```
> cd upgrade
```

4) Copy the eeprom/firmware/FPGA image files (*patch_img.bin*, *rt_fw.bin* and *rt_fpga.bin*) to the upgrade directory.

5) Run the Upgrade Tool:

```
> ./TSyncUpgrade 0
```

Where 0 is the board instance of the TSync-PCle to be upgraded.

6) When the tool completes its tasks, the board must be reset for the upgrade to take effect. This can be done without resetting the host computer by using the reset example program:

```
> cd ..
```

```
> cd examples
```

```
> ./SS_Reset 0 0 (Where the first 0 is the board instance of the TSync-PCle to be reset).
```

7) Wait for the board to restart.

Section 3: Updating the Tsync-PCle Timing board driver

The TSync-PCle's Linux, Windows or Solaris driver also needs to be updated to a newer version in order to support the Mobile mode of operation. (Note the TSync-PCle's firmware should be updated prior to updating the driver). This section discusses updating the driver.

With the TSync-PCle firmware now already updated, the card's driver can now be updated. The current Windows, Linux or Solaris driver (as applicable) should first be uninstalled, before installing the latest version of the applicable driver. After uninstalling the currently installed driver, install the new version of the applicable driver using the supplied driver files.

Section 4: Tsync-PCle timing board mobile mode configuration

In order for the TSync-PCle's GPS receiver to operate in a mobile environment, the GPS receiver needs to be programmed for Mobile mode. While in then Mobile mode, the GPS receiver will no longer lock-in a calculated latitude and longitude. Instead, it will continuously calculate its current position based on four or more received GPS satellites. To further optimize the GPS receiver while it's operating in the Mobile mode, the receiver can also be configured for the applicable mobile environment that it is operating in (airplane/helicopter, ship, automobile, etc) using a "Dynamics" code. The available Mobile mode Dynamics codes are "Land", "Sea" and "Air" (Note the "Stat" or Stationary Dynamics code is not used while in the Mobile mode).

The new version of the "GR_CA_RCVR_MODE" API Call as well as the "GR_GetMode" and "GR_SetMode" Example Programs (Which are included with the TSync-PCle Driver versions 2.04 or higher) all support switching the operating mode of the GPS receiver. These API Calls use two parameters for the Mobile mode: "GL_MODE" (For the GPS Receiver's mode) and "GL_DYN" (For the GPS Receiver's Dynamics code).

By factory default, "GL_MODE" is set to 1 (Standard Operation) and "GL_DYN" is set to 3 (Stationary). To enable Mobile Mode, "GL_MODE" must be set to 2 (Continuous Operation) and "GL_DYN" must be set to either 0 (Land), 1 (Sea), or 2 (Air), depending on your application.

This change in the GPS receiver's operation is persistent, even after the board power is either turned off or reset. Once a TSync-PCle board is placed into the Mobile Mode, the only way to return it to the Stationary Mode of operation is to set the "GL_MODE" to 1 and the "GL_DYN" to 3 using either the "GR_CA_RCVR_MODE" Set API Call or the "GR_SetMode" Example Program.

Note: The “GR_CA_DYNAMICS” API call as well as the Example programs (“GR_GetDyn” and “GR_SetDyn”) are deprecated and should not be used.

New Data Types implemented in the TSync-PCIe driver:

```
// The GL_DYN type defines the dynamics mode for the algorithms used in the GPS
// receiver used to model motion.
typedef enum
{
    GL_DYN_LAND = 0,
    GL_DYN_SEA = 1,
    GL_DYN_AIR = 2,
    GL_DYN_STAT = 3
} GL_DYN;

// The GL_MODE type is used to describe the operating mode of the receiver.
typedef enum
{
    GL_MODE_1SAT = 0,           // Use time/lpps with only 1 usable sat
    GL_MODE_STND = 1,          // Default receiver operation
    GL_MODE_CONT = 2           // Continuous position fixes (moving)
} GL_MODE;
```

New API Calls implemented in the TSync-PCIe driver:

GPS Receiver Mode Transaction (GR_CA_RCVR_MODE)

The GPS Receiver Mode transaction is used to either “get” or “set” the GPS receiver’s mode. The GPS Receiver Mode’s Error Response consists of a message header and an error code indicating a failure of the GR call to carry out the operation.

A) GPS Receiver Mode Command

The Receiver Mode command consists of a header as well as the GPS receiver mode and dynamics information when set and a header only with get.

Offset	Field	TYPE	Description
0	0x29	UINT8	GR Identifier
1	0x04	UINT8	Receive Mode item
2	control	UINT16	Get or Set
4	4 (Get only) 12 (Set only)	UINT32	Payload Length
8	inst	UINT32	Instance
12	mode	GL_MODE	Receiver Mode (Set only)
16	dyn	GL_DYN	Receiver Dynamics (Set Only)

Table 1: GPS Receiver Mode Commands

B) GPS Receiver Mode Response

The Receiver Mode “get” response returns the currently configured GPS receiver’s mode and the associated dynamics information. The Receiver Mode “set” response consists of the header only.-

Offset	Field	TYPE	Description
0	0x29	UINT8	GR Identifier
1	0x04	UINT8	Receive Mode item
2	control	UINT16	Get or Set
4	0 (Set only) 8 (Get only)	UINT32	Payload Length
8	mode	GL_MODE	Receive Mode (Get only)
12	dyn	GL_DYN	Receiver Dynamics (Get Only)

Table 2: GPS Receiver Mode Responses

C) GPS Receiver Mode Error Response

The Receiver Mode Error Response consists of a message header and error code.

Offset	Field	TYPE	Description
0	0x29	UINT8	GR Identifier
1	0x04	UINT8	Receive Mode item
2	control 0x0001	UINT16	Get or Set and Error Response
4	4 (or 8)	UINT32	Payload Length
8	ec	HA_RC	HA Error Code
12	rc	RC	Optional operation specific return code

Table 3: GPS Receiver Mode Error Responses

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