syn1588 ®

Abstract

The syn1588® PTP Stack supports many PTP profiles with different sync rates and varying requirements for the operation as PTP slaves. Additionally, there may be customer-specific requirements such as fast lock-in, fast setting and tracking time, or - contradicting - the handling of very high packet delay variations (PDV) or the prohibition of fast changes in the PTP servo control loop. This makes it necessary to adjust the servo control loop parameters for these individual requirements.

This application note helps selecting the appropriate basic parameter sets dependent on the application and the requirements. If you need further improvement, please contact the support of Oregano Systems.

Introduction

In the past, the syn1588® PTP Stack owned a simple PI control loop, an outlier filter and an averaging filter for higher sync rates. Today, the servo control loop is permanently updated due to the contradicting requirements in different application scenarios. The servo control loop now includes even non-linear elements. There are increasingly more features and also parameters that allow the configuration of these complex functions. Most of them are currently hidden for customers to avoid confusion. They can be made available on request for customers with special requirements.

We had to change the default parameters of the servo control loop in the last software releases to meet the average customer design. But they may be not always appropriate for every application. Thus, one has to be able to choose the parameters according to meet specific requirements.

Basic Parameters

In principle, best results will be achieved, when the Sync-Rate is identical to the Delay-Request-Rate (config-file: "delay_request_offset 0"). Basically, increasing the Sync-Rate will increase the precision.

Only some of the older parameters can be defined from the command line. Most of the servo control loop parameters have to be specified in a config-file. Please see the syn1588® PTP Stack section in the syn1588® User Guide for a detailed description of both the command line parameters as well as the config file parameters.

There are now two sets of PI controller parameters: For Out-Of-Sync and for In-Sync. At the time being, the transition between these control loops is defined by the parameter "sync boundary", which also defines the signalling of In-Bound or Out-Of-Bounds.

Other parameters control the "fast locking" for setting hard the time and rate only at the start of the syn1588® PTP Stack or - optionally - also when a certain boundary is exceeded (which is forbidden for most applications).

Advanced Parameters

Advanced, mostly non-linear features can be made accessible upon request:

- Non-linear filtering for longer time-periods
- Slew-Rate limitation of frequency changes

Please contact Oregano Systems support if you feel that you require access to these features.

Config File

First of all, we have to mention a bug in the config-files delivered with all our syn1588® PTP Stack releases of Q1/2018 and Q2/2018. Please comment out the following line in all config files:

```
inbound_delta_rate_max 0x80000
```

For commenting add a # character in the very first character of a line.

Many parameters use the unit "scaled ns", which means the value entered in the config file is nanoseconds $* 2^{16}$. The basic description of the parameters are given in the pre-defined sample config files e.g. "default.cfg". We will add here only some clarifications, if necessary.

We will provide here three different setups for fast / medium /slow control loop parameters. They can be used with all provided profiles. Please note, some profiles specify bounds for sync- and announce- intervals or a special value of the in- out- of sync indication (parameter "boundary").

Please be aware, that the config filename, when used, is the only parameter of the ptp command. This means, the parameters below have to be merged into one of the provided config files.

Common Parameters

These parameters shall be used for all three sets. We recommend to explicitly set the following parameters:

```
delay_request_offset  0
use_iir_filter true
use_spike_filter true
use_sample_rate_converter true
cold_start false
```

Please comment out following parameters, especially the delta_rate:

```
# outbound_delta_rate_max
# inbound_delta_rate_max
# lucky_filter_depth -1
# lucky_packet_median 1
```

Fast Parameter Set

The fast parameter set is intended for very fast start-up and fast locking. The local hardware clock will follow fast the frequency of the master, but will not efficiently smooth out the packet delay variations (PDV) of the PTP network. Best to be used only in networks with PTP-aware switches.

```
servo_props 25000, 1024, 0x8000, 0x8000, 4, 16
    inbound_pi_k 16700
    inbound_pi_t 512
```

Startup-time and switching between different masters will be faster when increasing the announce rate, e.g. from 0 to -1 or -2 (when supported by the master)

```
announce_interval -2
```

Slow Parameter Set

The slow parameter set is intended to filter large PDVs of large networks without PTP-aware switches. The time constants are significantly larger; therefore start-up time and lock-time are also large.

```
servo_props 2600, 16, 0x8000, 0x8000, 4, 16
    inbound_pi_k 880
    inbound_pi_t 2
```

Medium Parameter Set

The medium parameter set is in between the above described parameter sets and may be adopted to individual needs.

```
servo_props 7350, 128, 0x8000, 0x8000, 4, 16
    inbound_pi_k 5200
    inbound_pi_t 64
```

General Tips For Parameter Tuning

The first two entries of the "servo_props" parameter list are the outbound pi_k and pi_t values. They take effect after start-up and when the phase error is larger than the synchronization boundary (config file parameter "boundary", per default 1 us). It is recommended, to make the quotient of inbound and outbound pi_k values not larger than 3 or 4.

When changing the PI values, take an appropriate starting point (the values of the fast, medium or slow parameter set). When changing pi_k by a factor x, a good starting point is to change the pi_t by the factor x^2.

Advanced parameters

If you chose to experiment with Lucky Packet or median filtering because you have a network with very big PDVs:

Start with the slow parameter set and enable Lucky packet filtering for a maximum length of 4 seconds (lucky_filter_depth 2). Faster PI-parameters will lead to instabilities. We recommend to use a high sync-rate and set the lucky_packet_median parameter to 20% to 50% of the number of sync packets in this 4 seconds. (e.g. sync_interval -6 ==> 64 syncs per second ==> 256 syncs in 4 seconds (lucky_filter_depth 2) ==> lucky_packet_median 50 to 130

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