

IEC/IEEE 60802

PTP clock / ClockTarget / ClockSource / LocalClock

Requirements and assigned features

(Have additional a look at 60802-Steindl-EndStationModel-0321-v07.pdf)

Version V01 – September 2021

Günter Steindl (Siemens AG)

Industrial Automation

Synchronization quality and thus, measurement is defined between ClockSource and ClockTarget.

Thus, the requirements of the ClockTarget (and the ClockSource) influence (and are influence by) , together with the LocalClock, the 802.1AS errors.

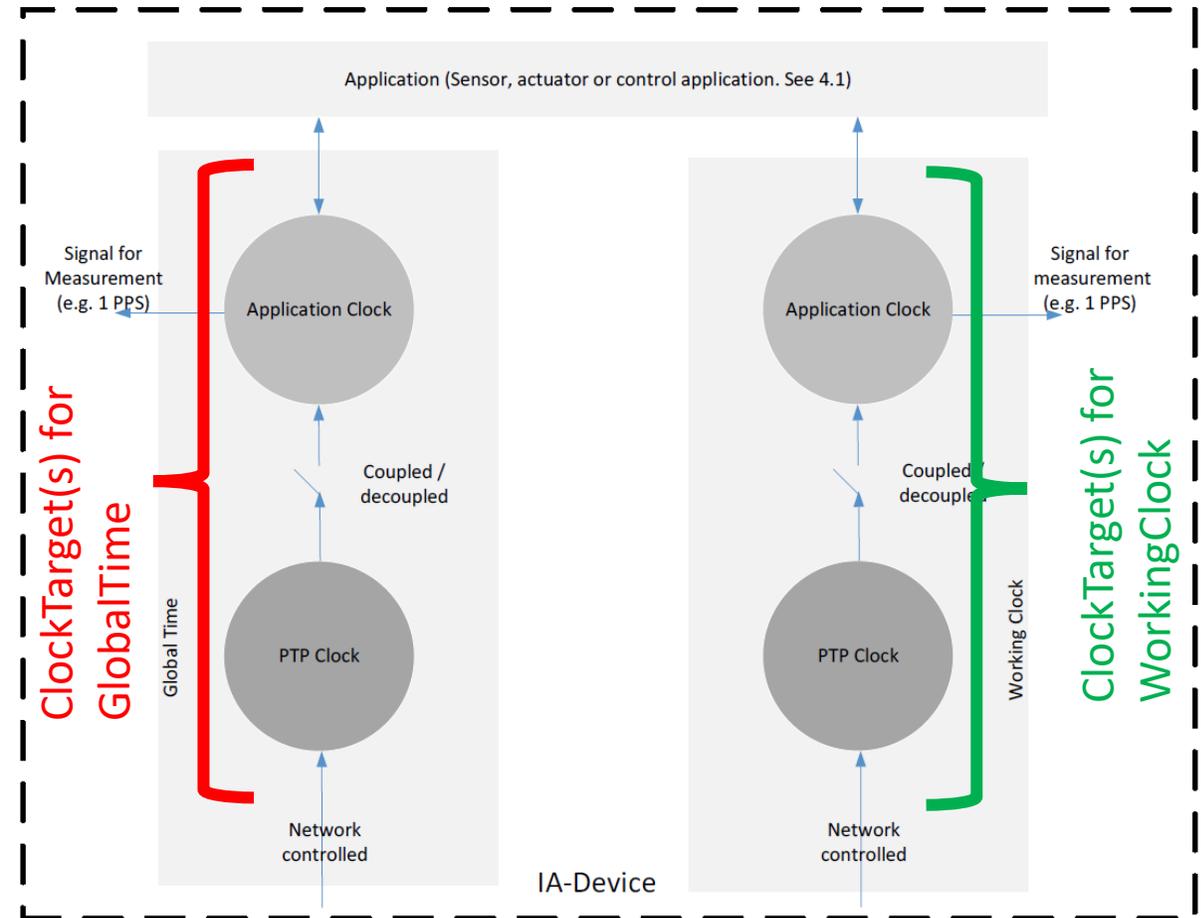
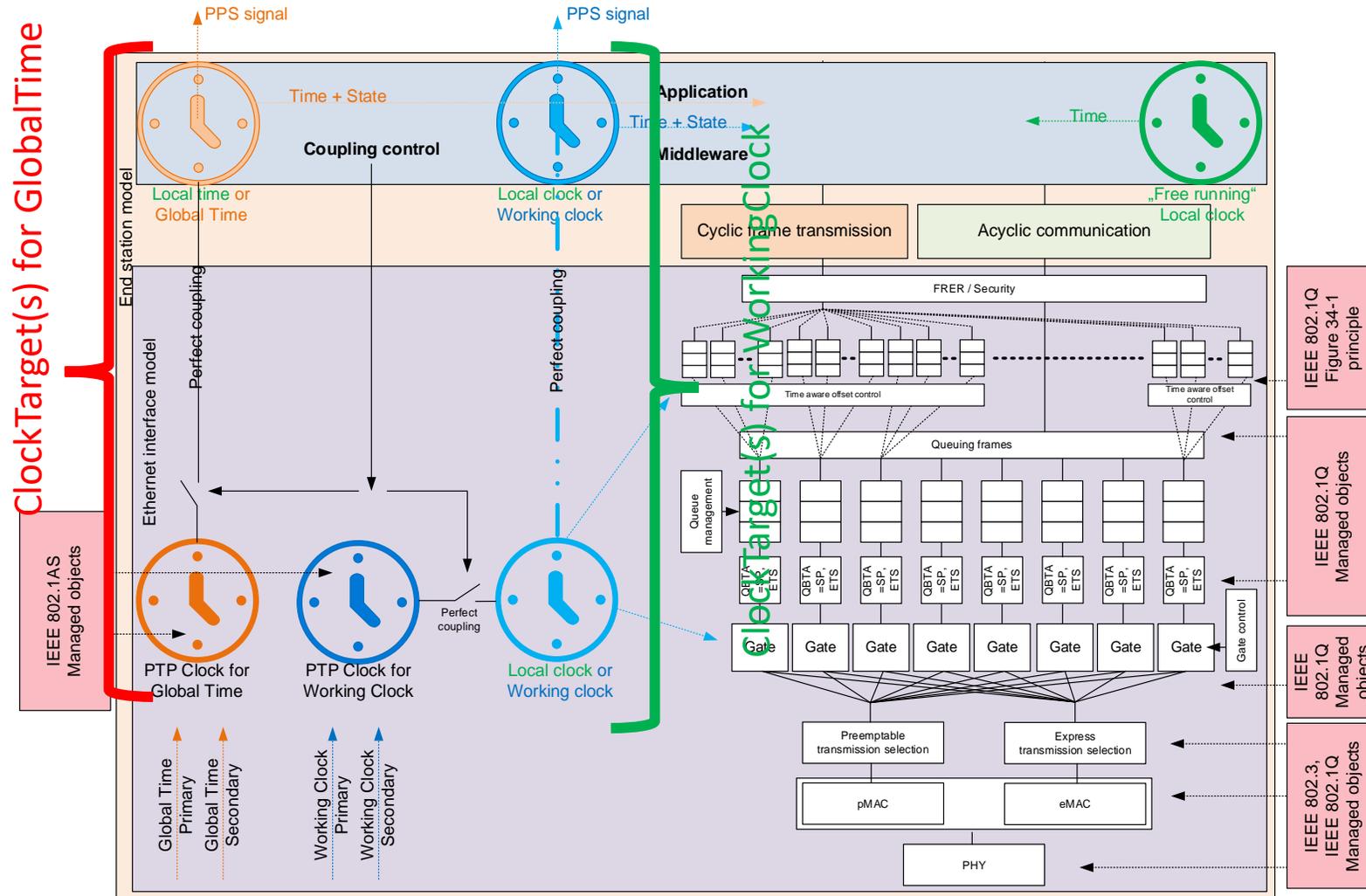


Figure 7 – Clock usage principles

Synchronization model



The end station interface and end station model needs to include synchronization.

Working Clock (**ClockTarget**) is used by both, end station interface and end station application.

Global Time (**ClockTarget**) is used by the end station application.

Application requires availability of Global Time and Working Clock at all times and thus, the end station maintains two instances of Working Clock and Global Time as **ClockTarget**.

The coupling of these two instances is controlled by the application.

Working Clock timescale is assumed as ARB.

Global Time timescale is assumed as PTP.

Additionally, (just for information) the application uses a free running **LocalClock** which make sure that even smallest timespans are only influenced by the oscillator quality.

ClockTarget and ClockSource

ClockTargets connected to PTP Relay Instances and PTP End instances that are not grandmaster capable shall meet the following requirements under all of its allowed working conditions and for its lifetime:

- a) The fractional frequency offset of its **ClockTarget** and its **LocalClock** relative to the TAI frequency is in the range of -50 ppm to +50 ppm.
- b) The absolute value of the maximum rate of change of fractional frequency offset of its **ClockTarget** is ≤ 3 ppm/s and of **LocalClock** ≤ 1 ppm. Note that this includes for the **ClockTarget** the affect of rate and offset compensation.
- c) During operation, the **ClockTarget time** increases monotonically, where monotonic means that for a time y that occurs after time x, the **ClockTarget's** timestamp of y is greater than or equal to the **ClockTarget's** timestamp of x.
- d) The **ClockTarget** of the PTP instance can be controlled by applying a frequency change over a period of time. This will also result in a phase change of the **ClockTarget**, as the phase of a clock is the product of the applied frequency change and the duration of time of the frequency change. The frequency applied can have a fine resolution in order to speed up or slow down the clock smoothly, and it has a total range of frequency adjustment.
- e) For the Global time, the total range of frequency adjustment shall be +/-1000 ppm over any observation interval of 1 ms, which means that the **ClockTarget** can change up to 1 μ s over an interval of 1 ms. This requirement shall be met during normal operation. At start-up higher rates of frequency adjustments are allowed.
- f) For the working clock, the total range of frequency adjustment shall be +/-250 ppm over any observation interval of 1 ms, which means that the **ClockTarget** can change up to 250 ns over an interval of 1ms. This requirement shall be met during normal operation. At start-up higher rates of frequency adjustments are allowed.

ClockSources connected to PTP Relay Instances and PTP End instances used as grandmaster shall ensure that their behavior allows the ClockTargets to stay in the above stated ranges. This includes the cases in which the **ClockSource** is controlled (affect of rate and offset compensation) by for example a GPS time source also.

Conclusion

Synchronization quality and thus, measurement is defined between ClockSource and ClockTarget.

That's the customer visible quality values!

- Any error analysis should include the whole path from ClockSource to ClockTarget!

Questions ?