Contribution ID: **319** Type: **not specified**

Timed I/O: Introducing Precisely Timed Platform I/O Driven by the System Clock

Monday 12 September 2022 17:00 (1h 30m)

Intel's 11th generation - and later - platforms have a Timed I/O capability. The Timed I/O logic outputs edge events synchronously using the platform clock or timestamps input edge events using the platform clock. The output trigger and input timestamp operations are implemented in hardware and are precise within 1 platform clock cycle. The platform clock also drives the clocksource (TSC) used for the system clock allowing event timestamps to be directly converted to system time.

Timed I/O is primarily used for exporting and importing time to the platform. An example of time import is using the PPS output from a GPS to determine the offset between the system clock and the GPS clock, adjusting the system clock to align to GPS time. Timed I/O can also export the system clock using a PPS 1 Hz - or higher frequency - signal to discipline an external device clock to align with the System clock.

GPIO may be used for both of the above applications but GPIO cannot timestamp input or actuate output with the same precision because clock correlation is performed by software. Timed I/O performs clock correlation in hardware and is precise within 1 platform clock cycle or about 25-50 nanoseconds.

We propose adding a new Timed I/O device type to support precise hardware timestamping and actuation of input and output signals based on the system clock. A Timed I/O device outputs singly scheduled edges or a train of edges with an adjustable output frequency. A Timed I/O device also timestamps and counts input edge events. Using the known nominal input frequency, the count is used to determine if an input event is missed and the frequency of the generating clock relative to the system clock.

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Yes

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Session Classification: BOFs Session

Track Classification: Birds of a Feather (BoF)