

Freescall i.MX8 DDR Performance Monitoring Unit (PMU)

There are no performance counters inside the DRAM controller, so performance signals are brought out to the edge of the controller where a set of 4 x 32 bit counters is implemented. This is controlled by the CSV modes programmed in counter control register which causes a large number of PERF signals to be generated.

Selection of the value for each counter is done via the config registers. There is one register for each counter. Counter 0 is special in that it always counts "time" and when expired causes a lock on itself and the other counters and an interrupt is raised. If any other counter overflows, it continues counting, and no interrupt is raised.

The "format" directory describes format of the config (event ID) and config1 (AXI filtering) fields of the perf_event_attr structure, see /sys/bus/event_source/devices/imx8_ddr0/format/. The "events" directory describes the events types hardware supported that can be used with perf tool, see /sys/bus/event_source/devices/imx8_ddr0/events/. The "caps" directory describes filter features implemented in DDR PMU, see /sys/bus/event_source/devices/imx8_ddr0/caps/.

```
perf stat -a -e imx8_ddr0/cycles/ cmd
perf stat -a -e imx8_ddr0/read/,imx8_ddr0/write/ cmd
```

AXI filtering is only used by CSV modes 0x41 (axid-read) and 0x42 (axid-write) to count reading or writing matches filter setting. Filter setting is various from different DRAM controller implementations, which is distinguished by quirks in the driver. You also can dump info from userspace, filter in "caps" directory indicates whether PMU supports AXI ID filter or not; enhanced_filter indicates whether PMU supports enhanced AXI ID filter or not. Value 0 for un-supported, and value 1 for supported.

- With DDR_CAP_AXI_ID_FILTER quirk(filter: 1, enhanced_filter: 0). Filter is defined with two configuration parts: --AXI_ID defines AxID matching value. --AXI_MASKING defines which bits of AxID are meaningful for the matching.
 - 0: corresponding bit is masked.
 - 1: corresponding bit is not masked, i.e. used to do the matching.

AXI_ID and AXI_MASKING are mapped on DPCR1 register in performance counter. When non-masked bits are matching corresponding AXI_ID bits then counter is incremented. Perf counter is incremented if:

```
AxID && AXI_MASKING == AXI_ID && AXI_MASKING
```

This filter doesn't support filter different AXI ID for axid-read and axid-write event at the same time as this filter is shared between counters.

```
perf stat -a -e imx8_ddr0/axid-read,axi_mask=0xMMMM,axi_id=0xDDDD/ cmd
perf stat -a -e imx8_ddr0/axid-write,axi_mask=0xMMMM,axi_id=0xDDDD/ cmd
```

Note

axi_mask is inverted in userspace(i.e. set bits are bits to mask), and it will be reverted in driver automatically. so that the user can just specify axi_id to monitor a specific id, rather than having to specify axi_mask.

```
perf stat -a -e imx8_ddr0/axid-read,axi_id=0x12/ cmd, which will monitor ARID=0x12
```

- With DDR_CAP_AXI_ID_FILTER_ENHANCED quirk(filter: 1, enhanced_filter: 1). This is an extension to the DDR_CAP_AXI_ID_FILTER quirk which permits counting the number of bytes (as opposed to the number of bursts) from DDR read and write transactions concurrently with another set of data counters.