Trigger Software Diagnostics

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1.   Execution times are monitored for each token.   The average time can be displayed at any time during a run.   The timer is the 8.333 MHz clock enabled in VME.   The number of clock ticks can also be displayed for each token.   The timer is started when (a) a DSM crate (or L1) receives a BUILD_EVENT command and is stopped immediately after the transfer of data to L2, or (b) when L0 takes the first word from the TCU Event FIFO and is stopped immediately after the BUILD_EVENT is sent either to L1 (Myrinet operation) or to the Data Concentrator (STP operation).

For any DSM crate: dsm_Times (or L1_Times for L1) will give the following:
BBC> dsm_Times
Number of tokens: 120
Min_time 1318, token 101   (The time given is in clock ticks)
Max_time 2186, token 57
Average DSM run time: 197.50 microsec

A similar display can be obtained for L0 with: L0_Times   In this case, an additional summary is given for the time to L2_ACCEPT.   This timer is started when L0 takes the first word from the TCU Event FIFO and is stopped on receipt of the ACCEPT command from L2.

For example:
L0> L0_Times
L0 execution time
Number of tokens: 120
Min_time 218, token 5
Max_time 708, token 27
Average L0 run time   : 34.37 microsec
L2 response time
Number of tokens: 120
Min_time 3262, token 104
Max_time 8709, token 71
Average time to accept: 499.27 microsec

If the command is   xxx_Times 1   then the time (in clock ticks) will be given for each token, followed by the summary shown above.

2.   Run Control specifies *maxTknInSystem*.   This is usually set to 120.   It must be understood that this refers only to the number of tokens that can be used by trigger and does not mean that all these tokens will be used by trigger at any one time. The number of tokens placed on the TCU FIFO is determined by L0 by means of a global variable: *throttle*. *maxTknInSystem* must be larger than *throttle* but otherwise its value has no effect on trigger rates (unless all 120 tokens are being used in DAQ in which case, no further triggers will occur).   I recommend a higher value, 250.

The RHIC clock rate is such that the DSM memory pointer will wrap round in (65536*RHIC clock period) msecs.   This is about 7 ms.   In order to avoid data

corruption, it is essential that for any token, the readout of DSMs is completed within 7 ms. The time to L2_ACCEPT is used as a measure and should not exceed 7 ms.

For a single token in the system, time to ACCEPT is typically 420 μsecs with Myrinet, or 220 μsecs with STP. Let this time be T. If the trigger rate is such that the trigger period is significantly less than these times, then L0 will take tokens from the TCU faster than can be processed and events will be placed in a queue. Clearly the first event will be dealt with in T but the ACCEPT for the last in the queue will take significantly longer than T and, without appropriate action by L0, could exceed 7 msecs.

Consequently, L0 will not allow more than *throttle* number of tokens to be active in trigger, that is, awaiting an ACCEPT decision, irrespective of the definition of *maxTknInSystem*. The L2 ACCEPT time is monitored by the TCU software and if it exceeds 6 ms for any token, the value of *throttle* is automatically decreased by *delta_step* and a warning is sent to the Operator's monitor window. This action will continue until errors are no longer observed or a minimum value *minthrottle* is reached for *throttle*. (This minimum value is currently 3.) The amount by which *throttle* has been reduced (*delta*) can be determined in a live system by typing:
L0_Dump

L0> L0_Dump
Token throttle   30
Delta throttle   15   Amount by which throttle has been dynamically reduced
Tokens available 120   This is maxTknInSystem
Tokens_in_pool   105   Number of available tokens for use
Tokens_in_trigger 13   Tokens in trigger awaiting an ACCEPT decision
Tokens_on_FIFO   1   Tokens on the TCU FIFO awaiting a trigger
Tokens in DAQ   1   ACCEPTed tokens now passed by L2 to DAQ
Tokens requested 40000   Events requested by Run Control.
Accept overtimes   76   Number of times L2_ACCEPT time has exceeded 6 ms.
Halt count   0   Number of DSM wrap-arounds. Serious error.[1]

The single token ACCEPT time can be determined simply by setting *throttle* to 1 and *delta_step* to 0. The *throttle* and *delta_step* variables are set to 30 and 5, respectively, when L0 is re-booted. If these are changed manually, they should be reset manually unless L0 is re-booted.

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[1] It is not clear that this TCU mechanism is operating correctly. It should show that a DSM wrap-around has occurred.