Requirements on the Global Level 1 Trigger

Trigger primitives are "data items" from which the Global Level 1 Trigger (GL1) makes the Level 1 trigger decision. There are two general "sources" of trigger primitives:

- Level 1 Trigger primitives, which are produced within the Level 1 hardware itself – generally on farms of computing elements (DSPs). These are the main physics triggers for the experiment.
- Front End Trigger primitives, which are trigger inputs from the front end electronics input directly to the trigger system through a special uniform interface. These are mainly for calibration, monitoring, debugging, and commissioning purposes.

The Level 1 trigger primitives are not required to arrive in any particular order. The Front End Trigger Primitives may be required to be available at a fixed time, presumed much earlier than the time required to compute the Level 1 Trigger Primitives. Global Level 1 must decide when it has all the inputs.

x.1 The Global Level 1 Trigger subsystem must accept trigger information from Level 1 Trigger processors and front ends at the full beam crossing rate of 7.6 MHz and must produce trigger decisions at an average rate of 7.6 MHz while incurring less than 1% additional dead-time

x.2 Global Level 1 must be able to inspect the trigger information for a crossing and test against a group of conditions, called a trigger list, to see if the crossing satisfies one or several of the conditions. It must apply a pre-scale to each crossing for each satisfied trigger. It must then OR the result to determine whether this crossing satisfies the trigger.

x.3To support logical partitioning of the data acquisition system, Global Level 1 must be able to maintain multiple lists of triggers and must be able to arbitrate if a given crossing satisfies more than one list

x.4 GL1 must create a trigger data packet for each accepted crossing which records which triggers were satisfied by the crossing . This packet should also contain the data from all of the trigger primitives suitably merged. This must be buffered either within Global Level 1 or in the event buffer so it can made available to the higher level triggers and also recorded as part of the output data for triggered crossings.

x.5 For diagnostic and monitoring purposes, GL1 must select events according to a prescale scheme and declare them as accepted. It must record that they were selected in this manner in the trigger data packet.

x.6 Global Level 1 must issue any signals to the buffer memory which are required to cause the crossing to be deleted from buffer memory if it does not satisfy the trigger and to be preserved for analysis by subsequent trigger levels if it satisfies the trigger.

x.6 GL1 must either maintain lists of crossings satisfied by each trigger list and be capable of supplying the next available triggered crossing number from that list in response to a request for a Level 2/3 processor OR it must send all the information to another device which does that function.

x.7 GL1 must maintain statistics required for the diagnosis of problems, for calculating dead-time, and for monitoring luminosity.

x.8 GL1 must contain a mechanism for dynamically throttling or pre-scaling some triggers so that triggers with a higher physics priority are taken. It must do this based on information concerning the luminosity and the availability of buffer memory.

x.9 In order to facilitate operation, it is permissible for GL1 to set a small “minimum L1 latency” which is guaranteed. This will set the time available for the formation of triggers and the generation of trigger data packets by the front ends. The absence of valid data from front ends will not be a cause for delaying the trigger decision.

x.10 In order to avoid problems with buffer memory and with GL1 processor memory, it is permissible to impose a ``timeout'' after which the GL1 will make a decision based on whatever information it possesses. The system will pass as triggered some pre-scaled selection of the crossings, which fail to have all information available for subsequent evaluation of the impact of these losses on the physics. (If this situation is sufficiently rare, all such failures could be declared to pass the trigger.) GL1 needs to record in the trigger data packet that the trigger passed due to a timeout and to maintain statistics on the frequency and nature of such occurrences.

Dependencies of the Global Level 1 Trigger

x.11 The computer resources in GL1 depend on the complexity of decision logic it must execute and the amount of data it must handle. It is desirable that the final processing part of each Level 1 trigger classify the crossing in a way that minimizes the task for GL1. Also, the amount of data should not exceed roughly 50 bytes per packet (and hopefully will be much less). The size of the front end trigger packets should be less than 10 bytes per front end. Even with these restrictions, the rate into GL1 will be around 1 Gbyte/sec.

GL1 must be able to receive whatever information is required from the buffer memory concerning the availability of space for events.

GL1 needs to have access to the current beam crossing number so that it can enforce various timeouts and other operations.

GL1 may need to have some information about the luminosity to determine whether dynamic prescaling is appropriate. (It may be possible to avoid this by having GL1 keep statistics about the luminosity through its own statistics collection function.)