Communicating Machine States via MDAT to the BLM Upgrade

J. Lewis

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MDAT is a serial signal that is repeated at 720Hz. The BLM machine state will be sent in MDAT frame $12 (hex). The MDAT frame is 24 bits consisting of an 8-bit frame identifier and a 16-bit data word, but the BLM system will use only the lowest 8 bits for 256 possible machine states. The state can be written by any Acnet-capable device to `T:MDAT12`. The state is sticky until it is overwritten. In order to prevent unauthorized changes to the state variable, this Acnet parameter will be protected to be accessible only from MCR consoles or devices. MDAT frame $12 will be shared between the Tevatron and Main Injector BLM systems.

From the perspective of the BLM system, an event occurs when the state changes. At that point, abort thresholds and masks may need to be updated. The update is estimated to take 1 ms. However, to avoid spurious aborts, one must take care to send events sufficiently before or after expected losses so that the running sums show high losses only when the thresholds and masks are set for that condition.

For each chassis, we will include a function code for each state or event. They are:

- **0 :** Event does not affect the chassis. No change will be made to the thresholds or masks
- **1 :** Change thresholds and masks to assigned values.
- **2 :** Change mask only and store previous mask. This is done primarily for F-sector. In this case, the mask is changed from one based on Tevatron operations to one for the P2/P3 beam permit.
- **3 :** Revert to the locally saved mask.

There are several use cases for BLMs in the Tevatron. The most common is in A-E sectors where losses come only from the Tevatron itself and the only thing to protect is the Tevatron. In these regions, there is no special behavior needed. In F-sector, beam leaking out of the P2 and P3 beamlines will greatly exceed Tevatron loss levels, but during normal operation does not present a danger to the Tevatron. Therefore, when beam is present in the P2/P3 line, Tevatron aborts should be masked off. One of the four running sums is expected to be used to protect against excessive losses from the P2/P3 beamline. MI events that correspond to beam sent in the P2 and P3 lines will also affect Tevatron BLM settings in F sector.

BLMs in the vicinity of the experiments are used to protect the silicon detectors from excessive radiation especially when the silicon is biased. Therefore, before the bias voltage is applied or lowered, the Tevatron state will need to be updated in MDAT. Because we will restrict access to `T:MDAT12`, the likely operating scenario would be that a detector control system would change an accessible Acnet variable prior to biasing the detector. A process running in the MCR zone can poll those variables and will set the MDAT word when appropriate to indicate the change of state and set thresholds for the BLMs near the interaction regions. The detector systems can then confirm the change to the MDAT state variable before raising the voltages.

Table 1 lists the expected machine states and the function codes associated with them for the various regions of the Tevatron and for the Main Injector.

Evt # (hex)	Event Type	A-E	F1	F2-F4	B0	C0	D0	MI
1	Proton Studies @ 150 GeV	1	1	1	tbd	tbd	tbd	0
2	Proton Injection	1	1	1	tbd	tbd	tbd	0
3	Activate Separators	1	1	1	tbd	tbd	tbd	0
4	Pbar Injection	1	1	1	tbd	tbd	tbd	0
5	Ramp	1	1	1	tbd	tbd	tbd	0
6	Squeeze	1	1	1	tbd	tbd	tbd	0
7	Scraping	1	1	1	tbd	tbd	tbd	0
8	HEP	1	1	1	1	1	1	0
11	CDF Silicon Biased	0	0	0	1	0	0	0
12	CDF Silicon Off	0	0	0	1	0	0	0
13	D0 Silicon Biased	0	0	0	0	0	1	0
14	D0 Silicon Off	0	0	0	0	0	1	0
15	BTeV Silicon Biased	0	0	0	0	1	0	0
16	BTeV Silicon Off	0	0	0	0	1	0	0
41	MI Injection	0	0	0	0	0	0	1
42	MI Flat-top pbar	0	2	0	0	0	0	1
43	MI Flat-top SY120	0	2	2	0	0	0	1
44	MI Flat-top Minos	0	2	0	0	0	0	1
45	MI Studies	0	0	0	0	0	0	1
46	MI End Flat-top pbar	0	3	0	0	0	0	1
47	MI End Flat-top SY120	0	3	3	0	0	0	1
48	MI End Flat-top Minos	0	3	0	0	0	0	1
49	MI Abort	0	0	0	0	0	0	1

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