Multicast Acnet Events

Description of message format

Tue, Mar 14, 2000

This note describes the UDP-based multicast message protocol that is used to deliver time-of-day and clock event timing information to Acnet front ends. This description is the result of studying what is present in these 15Hz messages.

The datagram is sent to UDP port 50090 via IP multicast address 239.128.1.4, or 0xEF800104. The time of its delivery is in response to Tevatron clock event 0x0F, which occurs at 15Hz at about 50 ms after the BMIN signal that marks the point of the lowest magnetic field of the Booster magnet system, which is about 16 ms ahead of the next 15Hz acceleration cycle. Operating at 15Hz, the Booster is synchronized to the line frequency, although it may vary in phase over about a 1 ms range. A test IRM node, node0509, receives these UDP multicast messages about 3 ms after it detects the 0x0F clock event.

The message format begins with the 20-byte netAPI header, which has the following format:

```
0100 0014 0002 0004 4143 4345 5645 4E45 0004 0000
```

The first word is the netAPI version number, which is referred to as 1.0. The second word is the length of the 20-byte header. The third word (0002) means it was multicast, as opposed to being sent to a single node (0001). The fourth word is the version number of the "facility," which seems to be 4. The 8-byte "facility signature" follows, which is here "`ACCEVENT`". The facility type code follows, which seems to be 4. The final word is reserved for netAPI header expansion.

The next part of the message looks like another header, perhaps:

```
0100 000C 01D7 DC63 0049 0045
```

The first word here may be another version number, perhaps 1.0 again. The next word may be the length of this additional header. The next two words form a 32-bit sequence number (most significant word first) that is incremented by one each time a message is sent. This allows for detecting missing UDP multicast messages. The next word is the message size of the entire UDP datagram. The last word is the message size of the previous datagram, sent one 15Hz cycle earlier.

The next 5 bytes are counts of the various types of event packets included in this message.

```
06 00 00 00 05
```

The first count is the number of Tevatron clock events described in this message. The next 3 bytes are reserved for counts of MIBS, RRBS, and TVBS beam sync events. The last one is the count of the Tevatron clock events sent for the previous cycle.

The next 7 bytes specify the time-of-day at the time of the 0x0F event, as obtained from a real-time clock chip in the sending system, which itself is synchronized to international time every five minutes. For example:

```
64 03 0E 0C 26 1E 37
```

These bytes have the meanings of years since 1900, month, day, hour, minute, second, and hundredths of second, so that this example represents March 14, 2000, at 1238:30.55.

The next part of the message is in 4-byte records, where the first 3 bytes are the time stamp (most significant byte first) and the 4th byte is a clock event number. The number of 4-byte packets are given by the first of the 5 byte-size counts described above. Note that multiple instances of the same clock event are not separately reported. (Perhaps the most recent instance is reported.)

All 3-byte time stamps in the message are in units of microseconds since the previous 0x02 clock event, which occurs every 5 seconds. (It is crystal-driven, so it is not synchronized with accelerator activity. This insures that it counts international microseconds, not something that breathes throughout the day with the power line frequency. Event 0x02 occurs every 5000000 microseconds.) The maximum value of a time stamp is therefore 0x4C4640.

If there are cases where beam sync events are reported, I have not seen them. If nonzero counts indicate their presence, they will have the same 4-byte structure as described above.

The final part of the message is a byte array of the clock events that were sent on the previous multicast message. There are no time stamps included for these. They are meant to give a kind of "second chance" for delivery of clock event data, in case of a missing UDP multicast message. One might be able to use this when the sequence number is observed to advance by 2 rather than 1.

Here is the complete example captured as this note was written:

```
0100 0014 0002 0004
4143 4345 5645 4E54    ACCEVENT
0004 0000 0100 000C
01D7 DC63 0049 0045
0600 0000 0564 030E    6 events, 03/14/00 1238:30.55
0C26 1E37 3165 0007    07: 3.237120
30A1 B811 30A1 B90C    11: 3.187128   0C: 3.187129
30D3 FF8F 3136 2C18    8F: 3.199999   18: 3.225132
3164 470F 0711 0C18    0F: 3.236935
0F
```

This message includes time stamps for clock events 07, 11, 0C, 8F, 18, 0F. It also says that clock events in the previously reported message were 07, 11, 0C, 18, 0F. It is typical that event 07 occurs first and event 0F occurs last. Note that although event 07 (the 720Hz event) is first in the list, its timestamp is largest, presumably because its most recent timestamp is used. The least significant byte for the first entry (07 event) is always 00, but I do not know why.