SYNCHRONIZATION

L. Trasatti

PROBLEM: move the setpoint of 100 elements in a time much shorter than the response time of a typical magnetic element (1 msec).

Let us consider two cases:

a) All the power supplies are in the same general area (a few m) and all of the elements to move are of the same type (e. g. quadrupoles).

In this case, a single VME HELL crate and a single DEVIL (3rd level CPU) can handle them all (e.g. all of the quadrupoles fit into 6 ADCs, 6 DACs, 6 digital I/Os):

Instead of the standard command,

SET QUAD54_2.5

we implement a new command, the SET MULTIPLE

SETM QUAD54,QUAD37,...QUAD100_1.5,2.5,...3.3

The DEVIL reads the command, prepares two vectors: DATA and ADDRESS, and then executes a FOR loop writing the data to the appropriate hardware. NOTE that a movement is always a VME write (typical 1 μsec).

Total time: 100 μsec in assembly language (LabView CIN).

b) The power supplies involved are in different geographical zones or the elements are of different kind and, in general, resident in different HELL crates.

We need a way to synchronize different DEVILs. In this case we implement another new command, SET MULTIPLE with TRIGGER.

SETMTRIG QUAD54,..QUAD100,ELEM22,..ELEM66_1.5,..2.5,3.3,..2.2

When the PURGATORY receives such a command, it prepares a table of the concerned HELL crates, decomposes the command into its constituent parts and builds one commands for each crate:

SETMTRIG QUAD54,...QUAD100_1.5,...2.5
SETMTRIG ELEM22,...ELEM66_3.3,...2.2

Then each command is sent to the appropriate DEVIL, who does not execute it, but prepares his vectors as above, empties his receiver FIFO from the optical link, answers to the PURGATORY with a

READY

message, and then waits in a tight loop for a

GO

command from the optical link.

The PURGATORY waits until all READY messages are in (with an appropriate timeout, abort, and so on, and so forth) then sends a sequence of GOs to the appropriate DEVIL. GOs are again VME writes (1μsec), and the OPLA optical link does not add appreciably to the jitter, thanks to its very simple write through architecture.

Optical fiber propagation times are of the order of tens of nsec, word transmission time is 160 nsec. So the total jitter between crates is:

Send GO to 10 DEVILs:	10 μsec
Tx jitter	<200 nsec
DEVIL exits tight wait loop	1 μsec
DEVIL sends vectors to 10 elements	10 μsec
TOTAL	<25 μsec

Of course, both procedures can be integrated in the PURGATORY, and the operator does not have to know where his elements are physically located.

In other words, make the basic structure simple and the problems will solve themselves. All this would be impossible using the standard network architecture.