NATIONAL RADIO ASTRONOMY OBSERVATORY

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VLA COMPUTER MEMORANDUM #113

DIGITAL COMMUNICATIONS SYSTEM COMMAND DRIVER

Preliminary Specification

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This memorandum is based on the DCS hardware system summary compiled by S. Weinreb, dated February 27, 1974. Reference should be made to this, the RFP-VLA-07, and to succeeding documents for information on the nature and behavior of the DCS hardware. Some descriptions are available of the nature of the devices controlled by the DCS (e.g. VLA Electronics Memo #124 by D. Thompson). However, there does not appear to be any comprehensive list of multiplex addresses in the system at the moment, and therefore, these cannot be included in this preliminary specification.

The program being described here is an intermediate level program, lying between the high level programs on the top, which do useful things like solving the array geometry problems and communicating with the outside world by way of CRT's, etc., and the device driver, which will handle the DCS interupts and pass the appropriate buffer parameters to the DMP. This program constructs a buffer for the use of the device driver. It is presumed that the buffer area is now empty. That is, that the DMP has output the previous buffer load since the last time this program was run. The program must complete before the next time the DMP is enabled for output to the DCS.

This task will generate four words of commands for each DCS serial line address every 50 ms. Each DCS word consists of three computer words. The first computer word contains a recognition pattern in the left byte and the serial line address (antenna address) and dataset address in the right byte. The second word contains a multiplex address in the left byte and the eight most significant bits of data in the right byte. The third word contains the sixteen least significant bits of data. Four commands per line, times 32 lines, times three words per command gives the buffer length of 768 computer words.

The four words will be allocated to various uses in a functional fashion so that, for test purposes, a given function can be disabled and its communications space allocated to a test program in a straightforward fashion. The functions of the four words are, respectively:

A--antenna drive commands.
B--normal observing, (lobe rotator, antenna drive enable (if needed), phase reversal, dataset reset, etc.).
C--observing setups (front-end switch select, LO select, subreflector motions, etc.).
D--manual interactions (remote tuning operations, test point intensive monitor select, etc.).

With each serial line is associated a control word, telling what to put in each of the command words. The bits of this control word have meanings as follows:

Bit 0--nothing is connected to this line - do not address it.
Bit 1--not an antenna associated line - special programs to be called.
Bits 2-7--(not used).
Bits 8-9--word A source.
Bits 10-11--word B source.
Bits 12-13--word C source.
Bits 14-15--word D source.

There are two bits, and thus four modes, associated with each command word describing the place from which the data for the command may come. These modes are:

Mode 0--normal mode - see descriptions below.
Mode 1--auxilliary mode - same as normal mode except for word C, q.v.
Mode 2--null mode - omit this command.
Mode 3--manual mode - see description below.

It is not clear that the DCS has sufficient capability to generate nulls in itself, and some computer assistance may be needed to generate null commands to keep DCS generated trash out of the way. However, where permissable, it is preferable for the DCS to generate its own nulls.

In manual mode the command driver will take its commands from a buffer filled by other programs, a separate buffer for each word (A, B, C and D). When the command driver finishes its operation it will advance the pointers for these four circular buffers (counting the number of times the pointer is reset to zero so that other programs can verify that the entire buffer has been output). In the buffer are three word command prototypes. If bit 1 of the first word is set, then the antenna address, in bits 8-12 of this word, is compared with the line address for which we are generating commands. If they are different, a null command will be generated. If they are the same, the three word command is put in the output buffer as is. If bit 7 of the command prototype is reset, then the current serial line address and the recognition pattern are OR'd into the first word, and this word and the following two of the command prototype are moved into the output buffer.

Note that to run a device, conceptually connecting it to a typewriter keyboard, all that is required is to place word D in manual mode, place the word which normally runs the device in null mode, and provide a simple program which accepts keyboard input and places it in the D manual buffer.

The normal mode includes a cycle of actions which depends on interupt count and on the word in question. The descriptions of the four normal modes is given below:

1. Word A normal mode.

On even numbered interupt counts, an azimuth is commanded. On odd numbered ones, a elevation is commanded. The command comes from the antenna control blocks, which are threaded together in the order of their serial line address. The first command word will contain the recognition pattern, the serial line address, and a DSA of 0 in the last three bits. The double word antenna coordinates will be picked up from the ACB (words 8 and 9 for azimuth, 10 and 11 for elevation). These values are right shifted 11 places (scaling S+12, least significant bit 2".5) or OR'd with the multiplex address, C0 for azimuth, C2 for elevation. The resulting doubleword is the second and third words of the output command.

2. Word B normal mode.

In normal mode word B goes through a sequence of 24 different activities, completing the cycle every 1.25 seconds. This cycle is given below:

Interupt count (modulo 24)	Activity
0	DS2 internal command (only every 10 seconds, nulls otherwise)
1	Antenna Drive Enable (if needed)
2-7	Nulls
8	Lobe rotator 1 rate
9	Lobe rotator 1 phase

10-11	LR 2 rate and phase
12-13	LR 3 rate and phase
14-15	LR 4 rate and phase
16-22	Nulls
23	Phase reversal pattern, for next 1.25 seconds.

The lobe rotator parameters come from the IFCB's. The IFCB's are strung together in groups of 4 (associated with each antenna), and ordered according to the multiplex addresses. Therefore the lobe rotator 1 parameters are found by examining the first, fifth, nineth, etc., IFCB. The lobe rotator 2 parameters are found in the second, sixth, tenth, etc., IFCB. And so it goes.

The fringe rate is IFCB words 4 and 5 converted to sign-magnitude representation (the least significant bit represents a fringe rate of 1.9 mHz). The phase is word 3, shifted right four places. In both cases the appropriate multiplex address must be OR'd into the left byte of the second word of the command. The first word of the command contains the recognition patterns, the serial line address, and the DSA=2.

The Antenna drive enable word is a word of zeros sent to Multiplex address C1 on the drive package (DSA=0).

The phase reversal pattern comes from a table of the Walsh functions of order 2^5, comprising two words per antenna, so that the first word and left byte of the second are sent during the first cycle, the right byte of the second word and the first word during the second, the second word and the left byte of the first word during the third cycle, the right byte of the first word and the second word during the fourth cycle, and then repeat.

3. Word C normal and auxilliary modes.

During normal mode, only the DS1 and DS3 initialize commands are sent, on interupt counts 0 and 1 (modulo 192) respectively.

The auxiliary mode is used for setting up the antenna for a new observation. Its operation is the same as manual mode, except that a different buffer is used, into which the initializing programs may place their commands.

4. Word D normal mode is the same as null mode.