WHS-458
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Subject: Auxiliary Memory Unit (AMU) Profile

INTRODUCTION

A study has been made into the use of the AMU during orbital operations. The purpose of this study was to: 1) Determine the different kinds of information that may be stored in the AMU; 2) Estimate the number of times information might be extracted from the AMU during a 30-day flight; 3) Predict (from item 2) if the AMU's specified access limitations will be exceeded for a 30-day flight; and 4) Determine the need for an optimum loading of the AMU to reduce the accessing problem.

PROPOSED AMU STORED INFORMATION AND NUMBER OF ACCESSES

It has been suggested that the following information would be stored and be accessed from the AMU. As noted below, most information must be accessed once for each photographic rev (anticipated to be from 10 to 13 times per day) while some others must also be accessed to support R&D events (anticipated to be from 0 to 3 times per day). The number of accesses for the other information is still under investigation. Therefore, the number of accesses listed for each item below is only a best estimate, but still provides useful information.

1. Target List

This data identifies, through a code number, latitude, longitude, altitude and other information for each target to be observed. It is anticipated that the information will be accessed once per payload rev, or ten (10) to thirteen (13) times per day.

2. Propellant Gauging Program

This program allows for the determination of the amount of gas propellant remaining in the propellant tanks used for attitude control. Depending upon the activity of the OV and the required monitoring, it is anticipated that access of the gauging information will be required from three (3) to five (5) times per day.

3. TLM Access Programming

This program allows the flight crew to use the LM keyboard to access any TLM point (except Gemini B) being sent to the ground. The resulting information is in percentage of full scale and not converted to engineering units. It is suggested that access to this program will be from thirteen (13) to sixteen (16) times per day. (Any OV contingency will greatly increase the number of accesses of the AMU for the TLM Access Program.)

4. Cue Present Program

This program is used to access the cues which identify/locate the targets and is accessed during target prepass activities. It is anticipated that such information will be required once per payload rev or from ten (10) to thirteen (13) times per day.

5. Payload Prepass Set-up Program

This program is used to access the targets from the AMU. This information will be required from ten (10) to thirteen (13) times per day.

6. Boresight Alignment Programs

This program is expected to be used once per day to align the tracking mirrors with the acquisition scope.

7. Servo Bias Determination Program

This program is used to determine the servo rate loop bias so that the main optics will be properly slaved to the acquisition scope. Access will be once per day.

8. DCSG Self-Test Program

This program is used to run operational checks on the DCSG components. Presently DAC and GE differ in their opinions on the importance and the frequency of performing these tests. GE feels that such programs are not critical to the successful completion of the mission requirements. Therefore, they recommend that such programs be located in the AMU and accessed approximately once per

orbit. DAC believes that the self-test programs should be run whenever the computer has time during its on-time. Therefore, they recommend that these programs be located in the computer core.

The content, the purpose, the duty cycle and, therefore, the location (computer core or AMU) of these programs are now being studied. Should these programs be located in the AMU, it is anticipated that they would be accessed from thirteen (13) to sixteen (16) times per day.

9. System Readiness Check Programs

These programs are used to run operational checks on the whole OV system to determine its readiness to perform mission operations. Presently DAC and GE also differ on the frequency and use of these programs. DAC feels that these programs will be frequently used and therefore should be located in the computer core. GE feels that these programs will be used only as necessary and therefore should not be located in the computer core.

The content, the purpose, the duty cycle and, therefore, the location (computer core or AMU) of these programs are now being studied. Should these programs be located in the AMU, it is anticipated that they would be accessed from thirteen (13) to sixteen (16) times per day.

10. Diagnostic Programs

These programs are used for limited isolation of malfunctions during contingencies. Nominally, it is anticipated that these programs will not be accessed. However, for planning purposes, it is anticipated that these programs might be accessed ten (10) times during a 30-day mission.

11. OV Sequence Programs

These programs are used in lieu of using numerous commands for the turn-on of certain subsystems that require a fixed sequence of steps. No firm need and recommendation has been expressed for the use of such programs and for their storage on the AMU. However, for planning purposes, it is anticipated that these programs might be accessed from

the AMU some twenty (20) times during a 30-day flight.

12. Remaining Programs

Executive control programs and mission critical application programs will also reside in the AMU. Nominally, these programs will not be accessed except when the content of the computer's fixed core is uncertain such as after a power interrupt. However, for planning purposes, it is anticipated that these programs might be accessed from the AMU some ten (10) times during a 30-day flight.

PREDICTED AMY ACCESSES

Table I sums up the number of accesses required of the AMU during a 30-day mission. Plans now call for the AMU accessed information of Item 1 through 13 to be put into what is called a dynamic core section of the computer(s) whereas all other information will reside in the fixed core section. The information in the dynamic core will remain there until replaced. This will preclude the bumping of fixed core programs which would have to be re-entered after the AMU programs and would require a total of two accesses to the AMU.

PREDICTED AMU ACCESS VS SPECIFICATION LIMITATIONS

The IBM AMU Procurement Specification states that, "The design of the AMU shall be such as to preserve or maintain magnetic tape life and its ability to meet the specified performance for a minimum of 1,000 full-length passes across the magnetic tape heads without tape replacement." The AMU contractor has further clarified this requirement by stating that the number of accesses of any one spot on the AMU tape is limited to 1,000. The predicted number of accesses listed in Table I assume that the information is located on the AMU tape in a random manner and allowing a 10% increase for accessing such things as executive programs. Locating the desired information would require a search of the whole AMU tape with the possibility of accessing all AMU data each time. Using this assumption, the orbital operations alone, without adding the accesses required for prelaunch and countdown checkout, exceed the requirements of the procurement specifications. However, optimum loading and spacing of the AMU information can

reduce the number of total accesses.

OPTIMUM LOADING OF AMU

The performance of photographic and R&D missions will be accomplished by completing a sequence of ordered events. While it is still being studied, it is anticipated that the first nine (9) items of Table I could be accessed in the order listed. Therefore, if these items are recorded on the AMU in the order listed in Table I and allowed enough space on the tape between each item for the tape to stop'start between readings, then each piece of information would be accessed only once for each photographic and/or R&D mission, plus a second time when the tape returns to the beginning of the sequence. Because the schedule of the accessing to the diagnostic programs, OV sequence programs and executive programs is random, it is assumed for the worse case that all items of information would have to be accessed in retrieving the diagnostic programs. So each of the first ten (10) items would be accessed each time the diagnostic program is retrieved or first nine (9) items for access to the OV sequence programs. This adds ten (10) accesses (plus ten more for return) plus nine (9) accesses (plus nine more for return) per flight to the number of accesses called for the first nine (9) items.

It is also assumed that there will be periods when additional accesses to the AMU will be required, such as reloading the fixed core during/following the periods of contingencies and to repeat a computer load from the AMU to increase confidence. Therefore, 10% additional accesses are added as a safety factor. It is planned that it will not be required to access the AMU to set up or perform an RTS pass. This control will be in the fixed core of the computer. Table II then sums up the number of anticipated accesses during a 30-day flight utilizing optimum AMU loading. Figure I shows a recommended optimum loading order for the AMU tape.

CONCLUSION

As the previous discussion indicated, required flight operational access to the AMU tape can readily exceed access limits of the procurement specification if the loading of the AMU is not considered. By optimizing

the AMU load, the required number of accesses can be reduced. Using the interpretation of the procurement specification stated earlier, optimization of the AMU load still does not reduce the access below the specification's 1,000. Therefore, a study is necessary to determine if a means can be found to increase the number of AMU accesses. If no means can be found for increasing the number of accesses, then it is suggested that flight operations be reviewed with the intention of reducing the number of times the AMU must be accessed for mission passes.

In addition, while not discussed in this report, test planning must limit the AMU accessing during in-house acceptance testing and pad checkout. It is anticipated that the AMU will be replaced during pre-launch checkout at VAFB because some 1,000 hours of testing are planned for at Huntington Beach and on the pad. However, control of the AMU accesses will still remain uncertain and this must be considered by those writing DCSG software and checkout procedures. A study is now underway to better define the anticipated AMU accesses required during acceptance and prelaunch checkout and a recommendation as to how and when the AMU will be changed.