

Network Operations Control Center Block III Modifications

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This article provides information regarding changes to the Block III Network Operations Control Center hardware and software implemented to support Voyager and Pioneer Venus Projects and the upgrading of the Deep Space Stations to the Mark III Data Subsystems Configuration.

I. Introduction

The Network Operations Control Center (NOCC) Block III configuration is in the process of being upgraded to provide the capabilities required to support Voyager and Pioneer Venus 1978 (PV78) Project commitments as well as to support Deep Space Station DSS changes arising from the Mark III DSN Data Subsystem (MDS) implementation. Figure 1 depicts the NOCC Configuration planned to become operational by June 1978. The dark-cornered blocks represent additions to the system configuration needed to support the following capabilities:

- (1) Increased high speed data (HSD) rates from 4.8 kbits/sec to 7.2 kbits/sec for eight full duplex and eight simplex HSD lines. The eight full duplex HSD lines are for input-output communications with the Deep Space Stations, while the eight simplex HSD lines are for monitoring HSD data transmitted to the DSS by other operating centers, such as JPL's Mission Control and Computing Center (MCCC).
- (2) Increased wideband data (WBD) rates from 27 and 50 kbits/sec to three full duplex lines at 56, 168 and 230 kbits/sec, respectively, scheduled to support Voyager and Viking extended missions.
- (3) Modification of the HSD and WBD block formats and block sizes. Block formats required to be processed are the current 33-bit error polynomial type as well as the new 22 bit error polynomial type for three different data block sizes, 1200, 2400 and 4800 bits per block.
- (4) Addition of an interface between the Network Log Processor (NLP) and the Ground Communications Facility (GCF) computerized High Speed Switch Assembly (HSW). The interface to the HSW will replace the direct high speed data input to the NLP as the GCF system converts to the new 22 bit error polynomial block format.
- (5) Modification to the NOCC Real-Time Monitor (RTM) software packages to accommodate the above identified changes (Items 1 through 4) as well as changes required to handle the new MDS-equipped DSSs and their modes of operation (Command Store and Forward; Tracking Variable Data Format, DSS Monitor Status to MCCC).
- (6) Modification to the NOCC Display Subsystem software to add (1) the new HSD and WBD block formats and sizes, (2) Operator Control Inputs (OCI) to

control the new data modes of operation for the Command (Store and Forward) and Tracking (Tracking Variable Data format) RTMs, (3) 13 new tracking variable data display formats, and (4) the third telemetry RTM display formats and OCIs.

- (7) Modification to the Data Records Processor software to add the capability of recalling and merging HSD and WBD from MDS-implemented stations, as well as to add the capability to generate Intermediate Data Records (IDR) tapes from the NLP log tapes, the DSS Telemetry Processor Assembly (TPA), wideband Original Data Records tapes, and DSS Communications Formatter Assembly (CMFA), high speed data Original Data Record tapes. Included will be the capability to generate tracking data and radio science IDR's.
- (8) Modification to the NOCC Network Support Controller (NSC) hardware and software to (1) add a second terminal to support Command Store and Forward operations, (2) accommodate HSD block format changes, (3) provide transmission of binary predicts to the DSS Metric Data Assembly (MDA), and Radio Science Predicts, and (4) accommodate changes to RTM interfaces with Subsystem Performance Records and Standard Limits files.
- (9) Upgrade of NOCC test and training to allow remote control of the Simulation Conversion Assembly (SCA) and new Voyager and PV'78 telemetry simulation data types.
- (10) Upgrade of the Video Assembly Processor software to provide three channels of digital television displays containing high-resolution graphical presentations of radio science tracking data parameters.

II. Hardware Configuration Changes

The following hardware changes to the NOCC Block III configuration have been made to support Voyager, PV'78, and MSD-configured Deep Space Stations:

- (1) Addition of a third NLP processor to handle the added high speed wideband and GCF high speed switch processor interface data traffic.
- (2) Addition of a third NCE processor to interface with the added third NLP.
- (3) Addition of four magnetic tape transports to handle the added logging of high speed, wideband, high speed switch data.

- (4) The addition of a second remote computer terminal between the Network Support Controller (Sigma 5) and Command Operations work station in the DSN Network Analysis Team (NAT) area.
- (5) The addition of two NOCC Digital Television (DTV) channels with drives and synchronization modules to support the Voyager Project through an interface with the MCCC video distribution system.
- (6) The addition of peripheral equipment, such as wide-band communications buffer assemblies and 230-kbit modems required to support the above identified major installations.
- (7) The addition of core memory (to 80k words) and disc storage (to 50 megabytes) to the Network Support Sigma 5 computers required to support expanded tracking predict generation, as well as providing capability to handle the increased volume of data required to support Voyager, PV'78 and DSS MDS subsystems.
- (8) The addition of core memory to the Video Assembly Processor and three DTV channels required to support radio science high-resolution graphical displays.

III. Software Configuration Changes

Figures 2 through 9 depict in block diagram form each of the major NOCC subsystem software programs. As noted in the software block diagrams, the dark-cornered modules indicate where the software underwent modifications to comply with the added set of requirements identified in Section I herein.

The following paragraphs provide a short description of the program module modifications:

A. Network Log Processor (NLP)

A new Star Switch Controller (SSC) handler is being implemented to allow interfacing of the NLP to the GCF HSW. This handler is required to process the 22-bit polynomial-type high speed data blocks transmitted on 1264-bit block message format that includes an intracomputer control subheader and a message checksum word.

The routing and buffer pool control modules were modified to accommodate new 4800-bit block size (Voyager wideband) and packing of four 1200-bit or two 2400-bit blocks into a 4800-bit block transmission to and from the NCE. In addition, these two program modules were modified to allow packing eight 1200-bit, four 2400-bit or two 4800-bit magnetic tape log records for logging as well as directly transferring data to the DRP during ODR recalls from the TPA, CMF and Radio Science Occultation Data Assembly.

B. Network Data Processing Area Communications Equipment (NCE) Software (Fig. 3)

The NCE's routing buffer pool and control program modules were modified to allow transmission and reception of 4800-bit blocks from the NLP, as well as to allow operation using two active NCE's at the NOCC's NDPA area in Building 202.

C. Data Display Processor (DDP) Software, (Fig. 4)

The display software was updated to include the many display parameter mnemonic name-changes brought about by the MDS system implementation of the Deep Space Stations, as well as modifications to the buffer management program modules to allow processing of Voyager 4800-bit block raw data destined for the line printer in the DSN NAT area.

D. Real-Time Monitor Program Changes (Fig. 5)

Figure 5 depicts the typical NOCC Real-Time Monitor (RTM) software block diagram. All of the RTM processors have been modified to include the processing of data transmitted by the MDS-equipped DSSs, as well as the processing capability to support Voyager and Pioneer Venus 1978 (PV'78) as follows:

- (1) Monitor RTM. Addition of new DSS monitor data block processing and transmission of selected DSS monitor data to the Voyager Project (820 – 13 module MON 5 – 8).
- (2) Telemetry RTM. Addition of Voyager and PV'78 high speed and wideband telemetry processing, as well as the addition of a third telemetry stream (TLM-C). Telemetry C software is expected to operate in the NDPA's spare RTM whenever the scheduled telemetry stream loading is greater than the 18 streams currently handled by TLM-A and TLM-B.
- (3) Tracking RTM. The tracking RTM software has been updated to include the processing of data transmitted by the DSS Metric Data Assembly (MDA) and the handling of the new variable tracking data high speed block format (820-13 module TRK 2-14), which provides for an additional 13 new display formats available to operations via the DTV displays in NOCC.

- (4) Command RTM. The command RTM software has been modified to include the processing of data transmitted to and from DSS Command Processor Assembly (CPA) and the handling of Command Store and Forward capability in accordance with 820-13 module COM-4-4.

E. Network Support Subsystem (NSC) Software (Fig. 6)

The Sigma 5 operating system software was updated to include the added core and disc storage hardware expansions. In addition, smaller updates were made to the high speed I/O handlers due to the new block formats as well as the changes brought about by the DSS MDS upgrade, Voyager/PV'78 support requirements and new Tracking and Radio Science binary predict generation.

F. Data Records Processor (DRP) Software (Fig. 7)

The Data Records Processor software has been updated to include the capability to handle 4800-bit Voyager wideband data blocks, automatic ODR recall from the DSSs TPAs and CMFs, and the generation of Intermediate Data Records (IDR) tapes for Tracking and Radio Science support. The IDR tapes can be produced from previously generated IDRs, via merging DSS-logged TPA and CMF ODRs and merging NDL log tapes and fill tapes generated via an automatic recall of missing data blocks.

G. Test and Training (NTT) Subsystem (Fig. 8)

Test and training software was updated to include 4800-bit block size data handling, the addition of DSS Simulation Conversion Assembly (SCA) Control and Text Data, high speed data block processing, and Real-Time Monitor software test block generation which simulates a Deep Space Station interface to the RTMs.

H. Video Assembly Processor (VAP) Software (Fig. 9)

The Video Assembly processor software is being updated to include the capability to display up to 12 high-resolution graphical plot presentations of Radio Science data derived from the DSS tracking data stream. New OCIs for the control and selection of the graphical data are being added, as well as the handlers to interface the new DTV channels and tracking data from the tracking RTM.

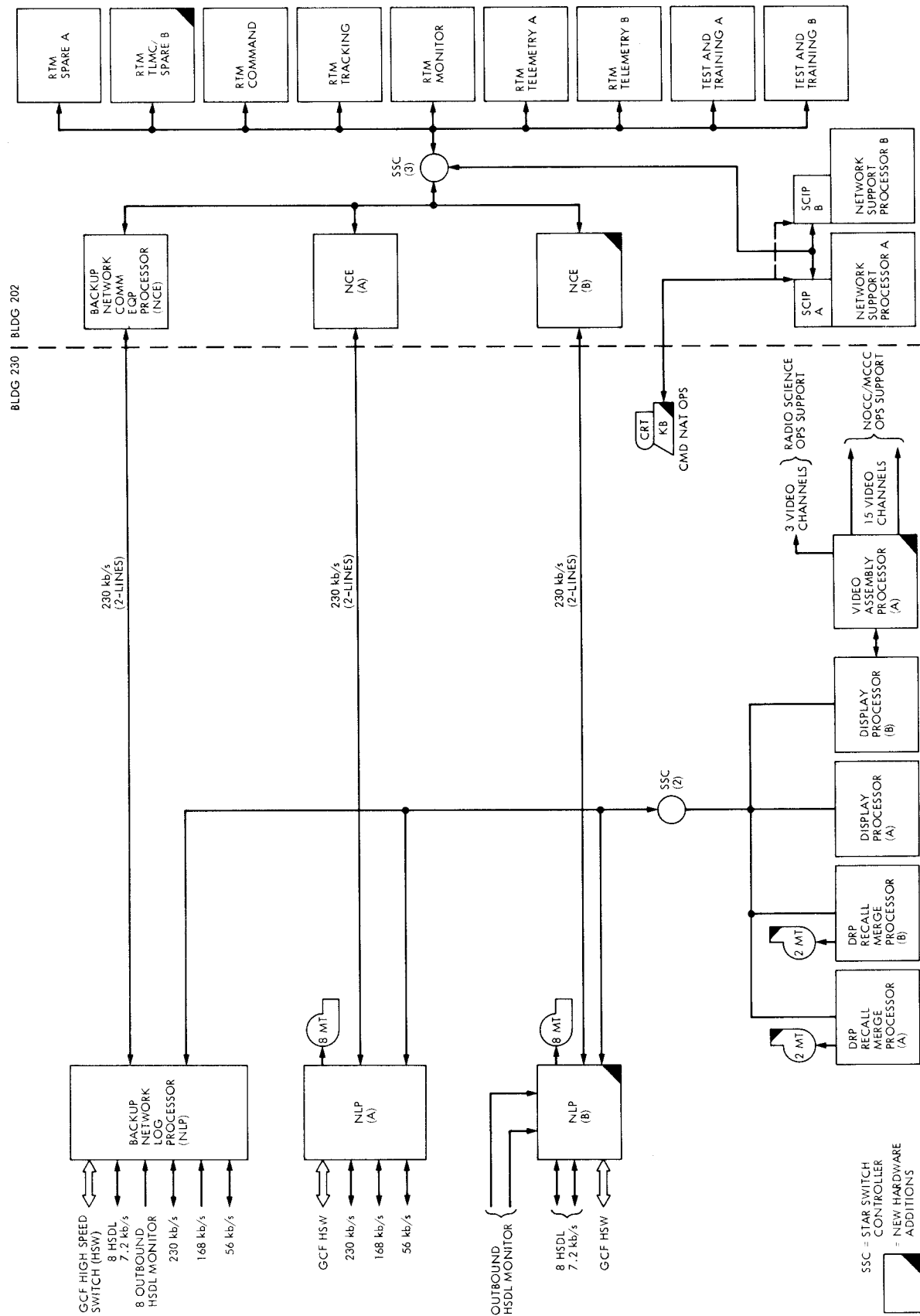


Fig. 1. Network Control System Block III Configuration (June 1978)

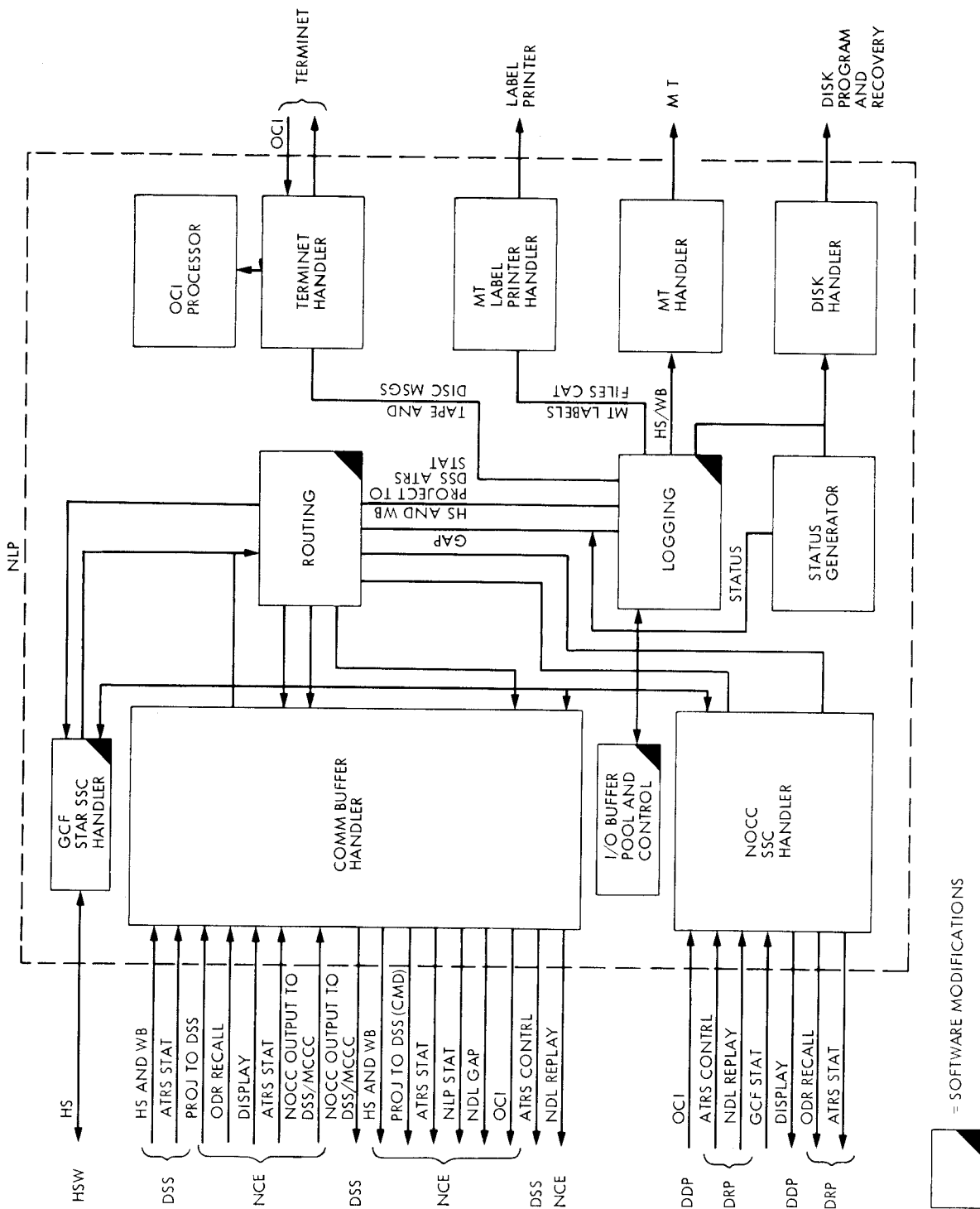


Fig. 2. Network Log Processor Software Module Diagram

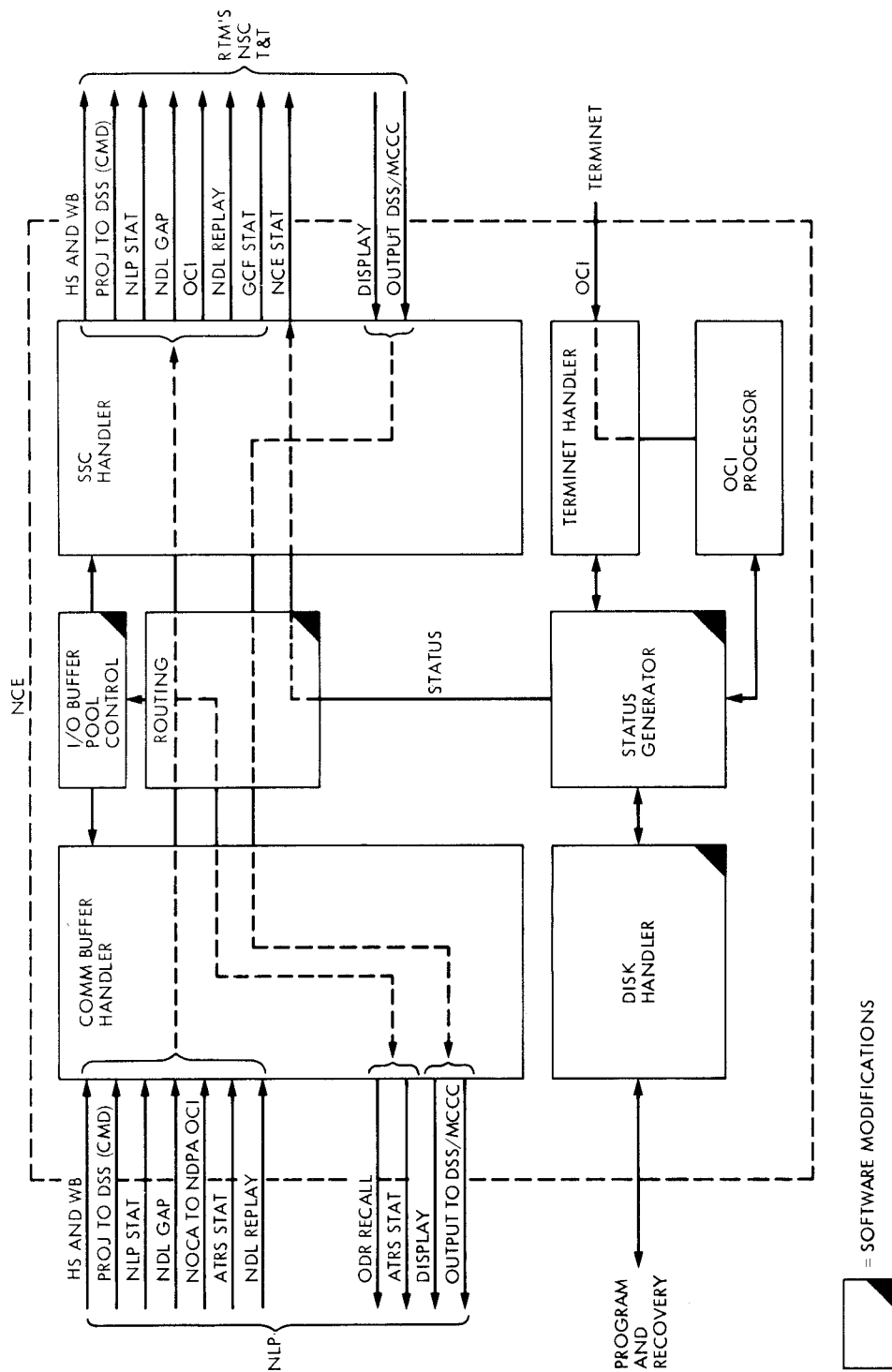


Fig. 3. Network Data Processing Area Communications Equipment Software Diagram

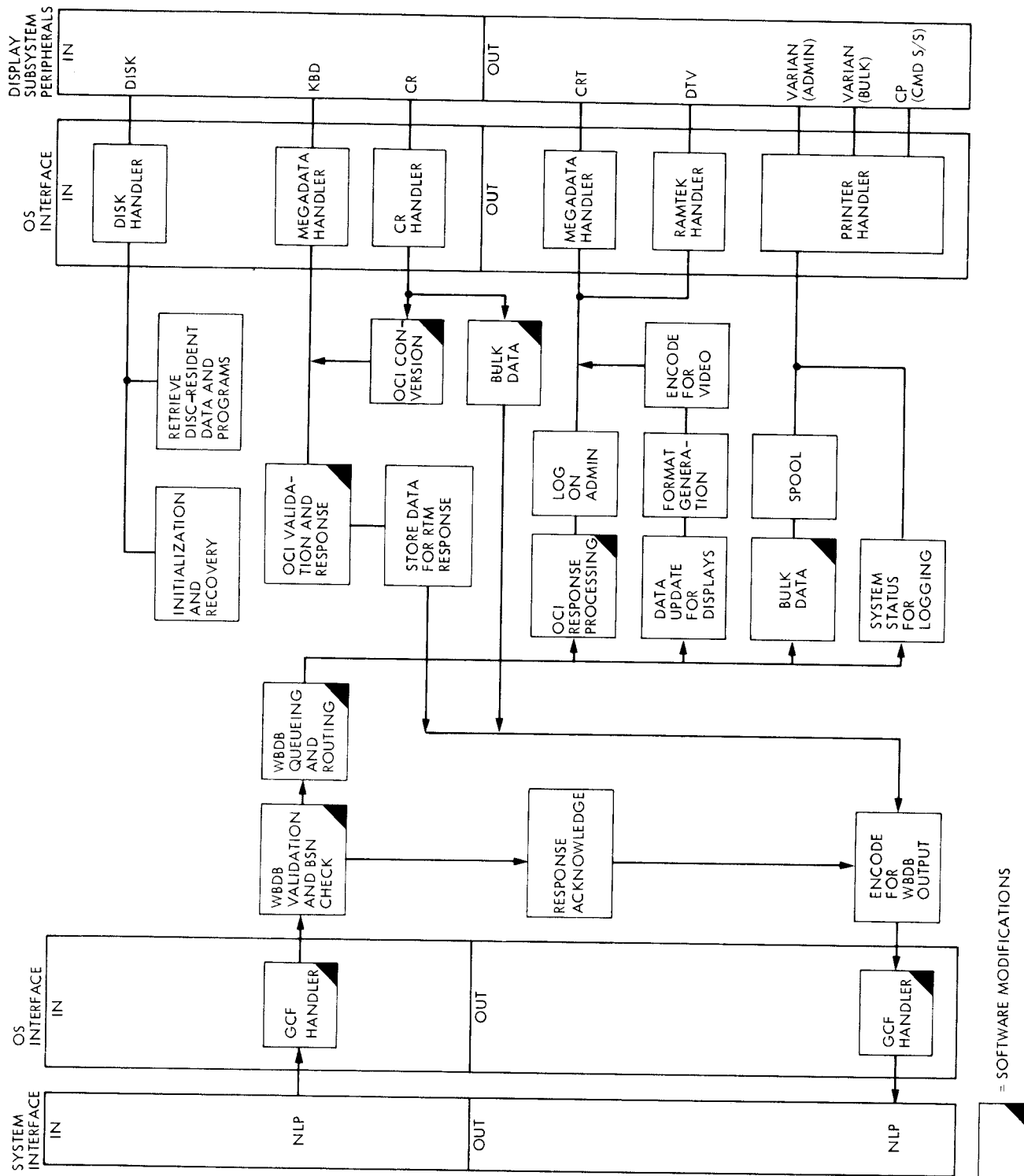


Fig. 4. Data Display Processor Software Module Diagram

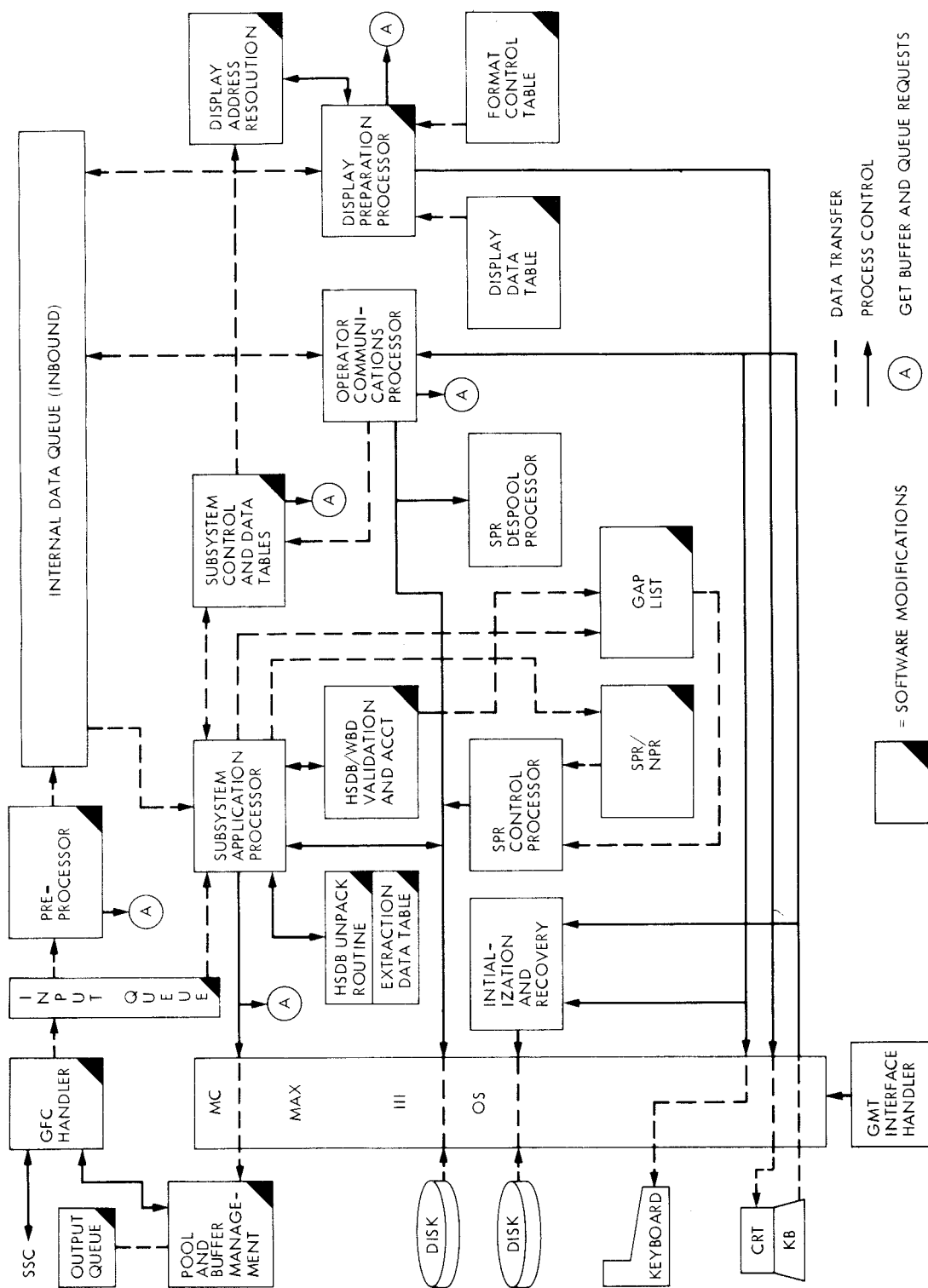


Fig. 5. Typical Real-Time Monitor Software Module Diagram

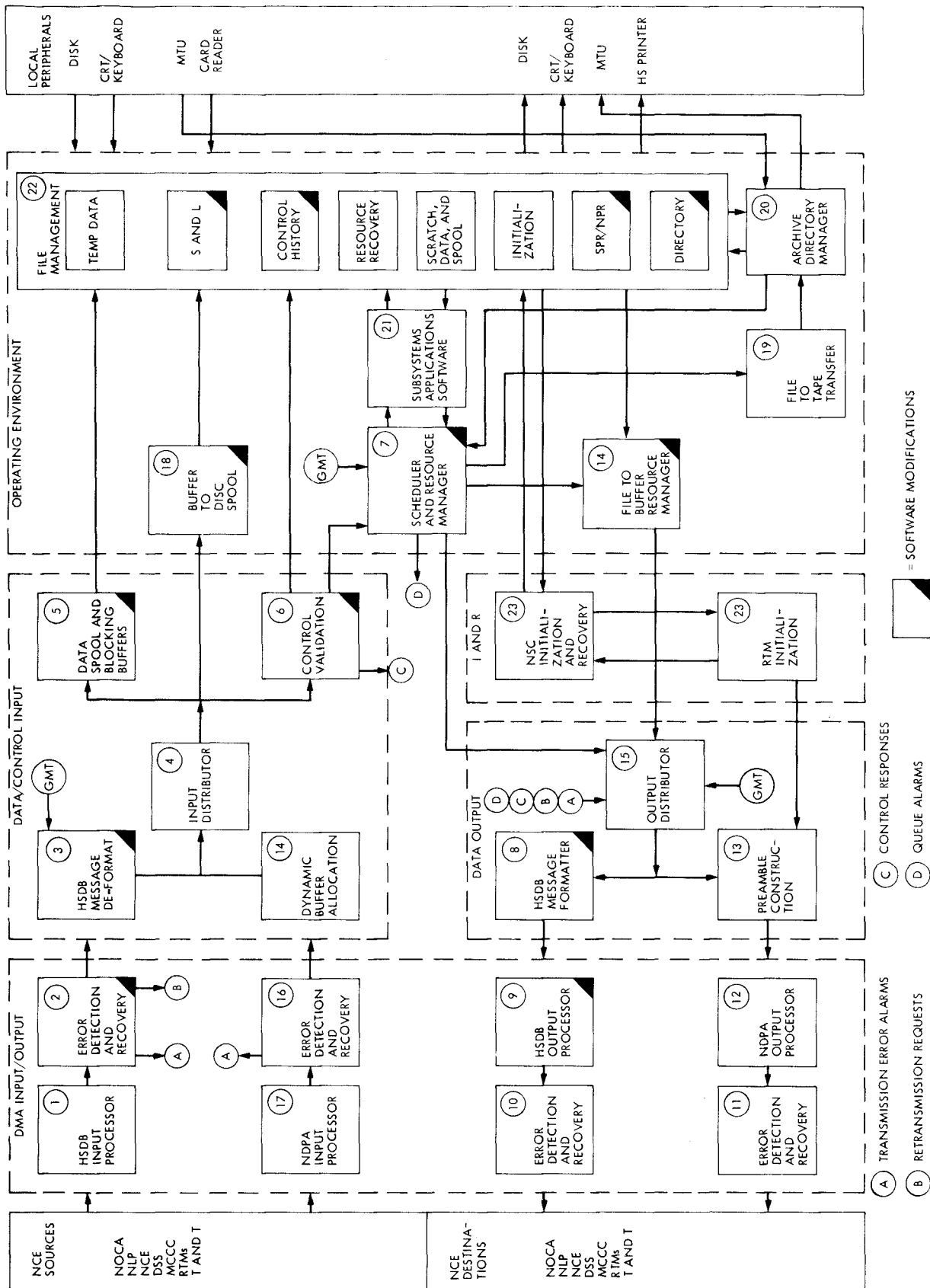


Fig. 6. Network Support Subsystem Software Module Diagram

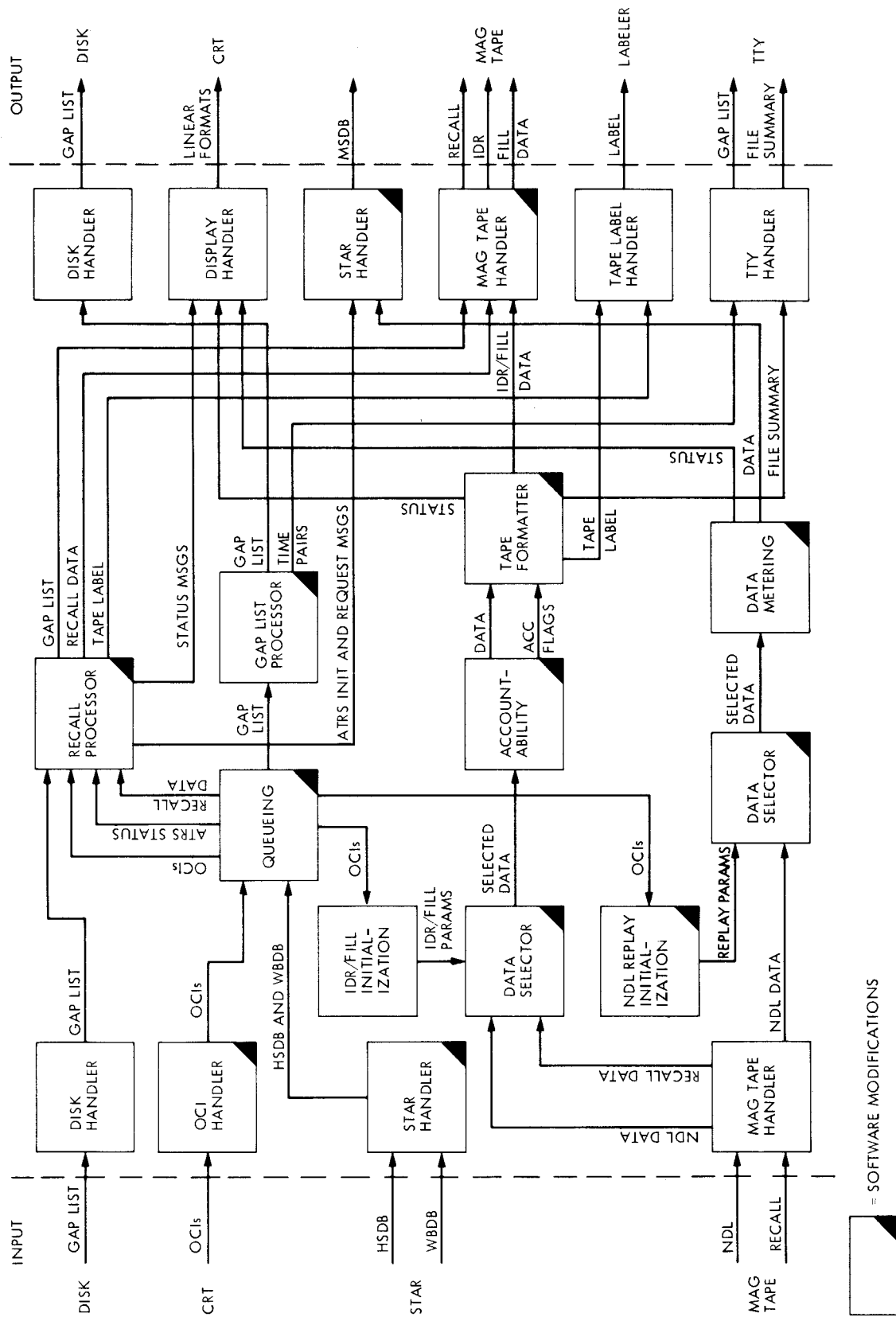


Fig. 7. Data Records Processor Software Module Diagram

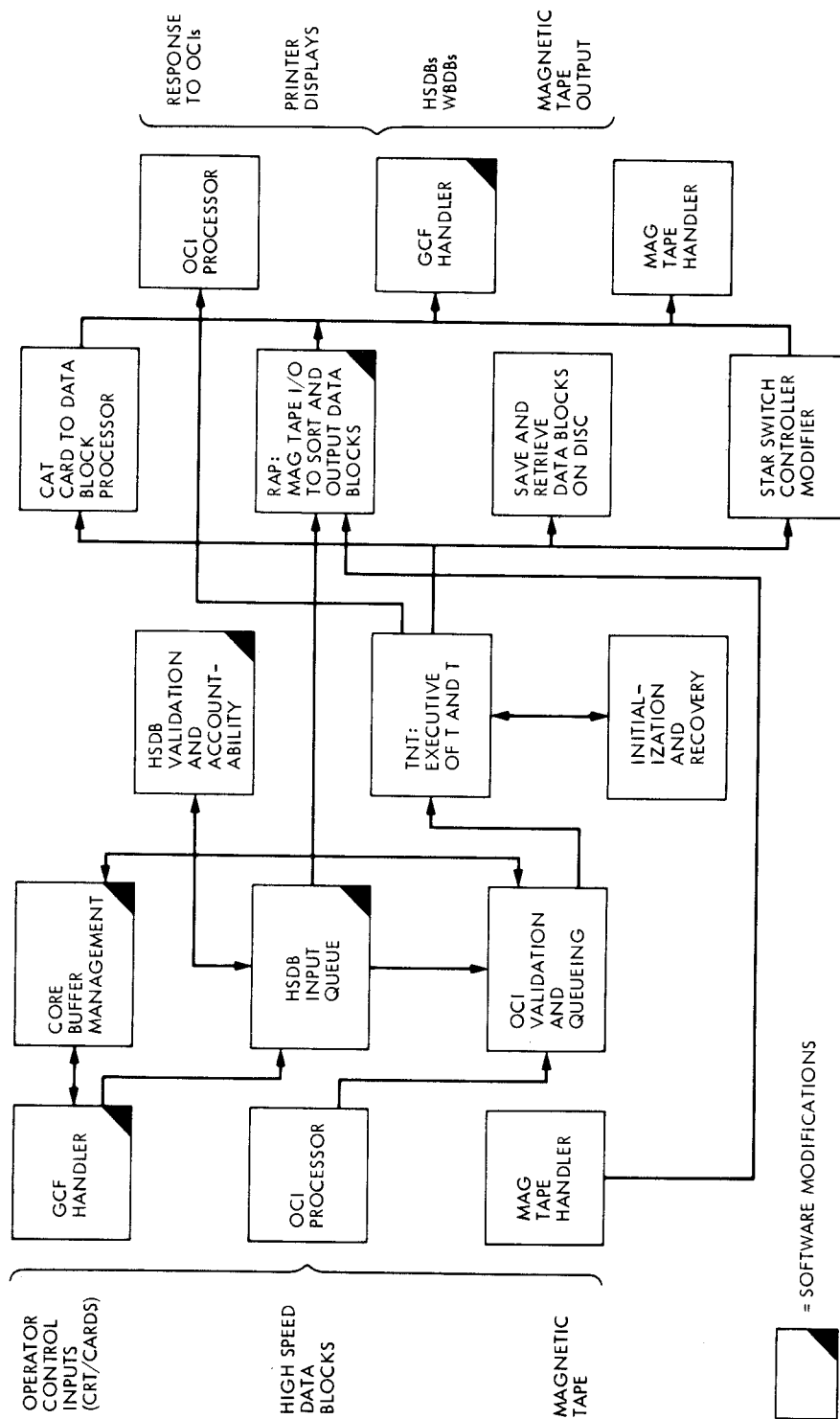


Fig. 8. Test and Training Subsystem Software Module Diagram

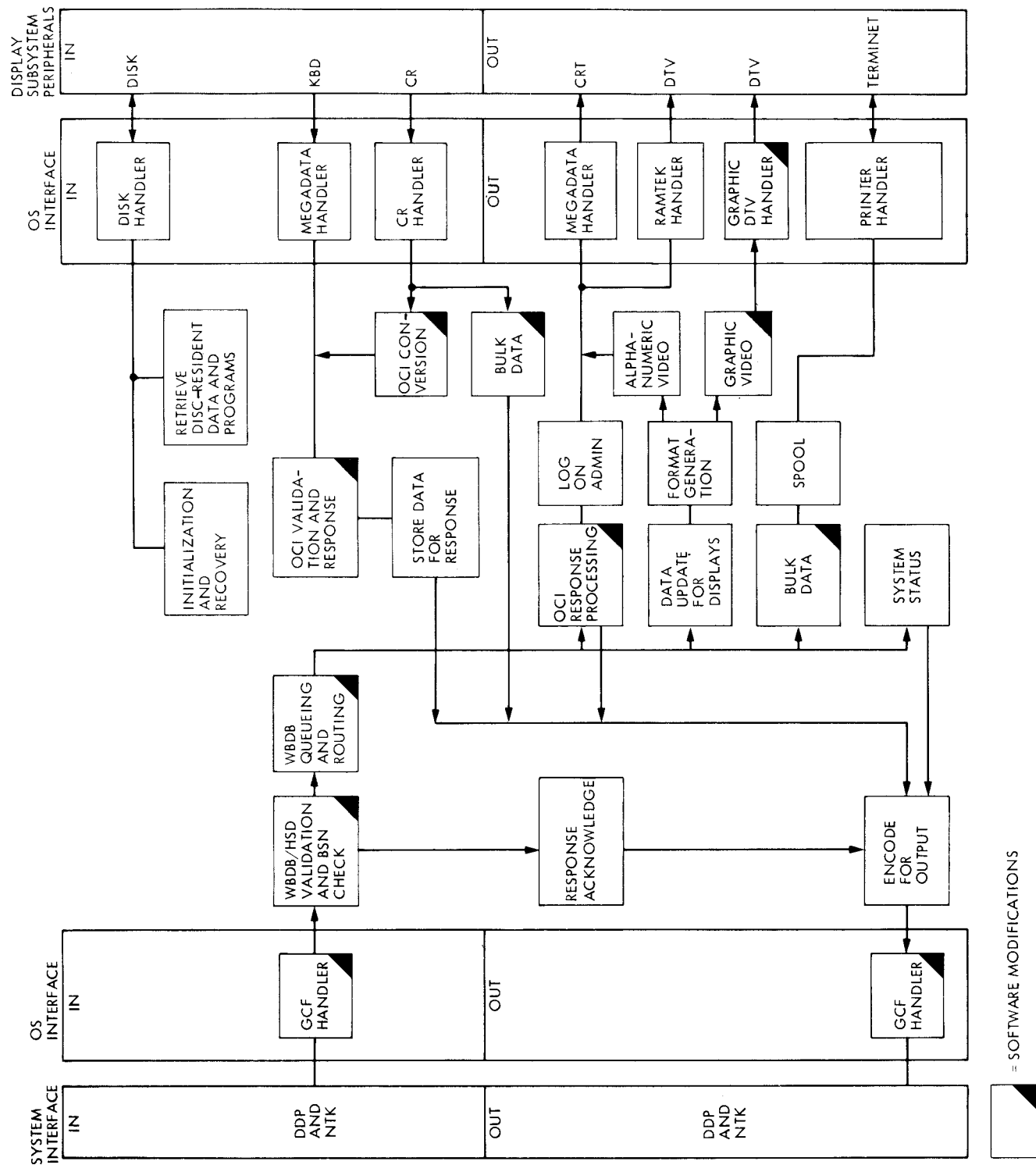


Fig. 9. Video Assembly Processor Software Module Diagram