# DSN Monitor and Control System, Mark III-78

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*A description of the DSN Monitor and Control System, Mark III-78, is discussed. The major implementation required to evolve from the Mark III-75 to the Mark III-78 configuration is also discussed.*

## I. Introduction

The DSN Monitor and Control System, as well as the other DSN systems, has undergone a significant evolution from late 1976 through the major portion of 1978. This evolution has resulted in the Mark III-78 configuration. Major implementation occurred in each of the three DSN facilities: Deep Space Stations (DSS), Ground Communications Facility (GCF), and the Network Operations Control Center (NOCC). At the DSS, implementation of new computers for the Telemetry, Command, Tracking, and Radio Science Systems significantly changed the DSN Monitor and Control System. In the GCF, implementation has occurred at the stations and at JPL in the central communications terminal. A major software upgrade occurred within the NOCC due to the changes at the stations and the Ground Communications Facility.

The DSN Monitor and Control System, Mark III-78 configuration is multimission and is utilized by the DSN to support the Pioneer 6-11, Helios 1 and 2, Viking, Voyager, and Pioneer Venus 1978 missions. Figure 1 provides a block diagram of the DSN Monitor and Control System, Mark III-78 configuration.

## II. Deep Space Station

As part of the DSN Monitor and Control System, the DSS Monitor and Control Subsystem (DMC) provides two primary functions: (1) the DMC provides the central control and monitor capability for the stations, and (2) the DMC receives control data from and furnishes monitor data to the NOCC for Network Central Control and Monitor purposes.

There are three major assemblies of the DMC that accomplish the above two functions. The three major assemblies are:

(1) An XDS 920 computer.

(2) A station monitor and control console.

(3) A special input-output terminal.

### A. XDS 920 Computer

The XDS 920 computer has been a part of the DMC for many years. Its designation is the Digital Instrumentation Subsystem (DIS). It has been utilized as a central collection point for station monitor data and interfacing with the NOCC. For collecting station monitor data, the DIS has interfaces with all of the station subsystems. The station monitor data are accumulated by the DIS and displayed to the station operator located at the station monitor and control console. Additionally, a subset of this station monitor data is sent to the NOCC for Network central monitoring purposes. A significant implementation effort was undertaken for the DIS to convert from the Mark III-75 to the Mark III-78 system.

Major interface changes occurred with the implementation of new computers in the DSS Command, Telemetry, Tracking, and Radio Science Subsystems. The interface with these subsystem computers is via the DSN standard computer-to-computer intercommunication device, a star switch controller. Significant implementation was required for the DIS to operate in this computer network. The new generation computers are approximately 10 times as fast for memory cycle time and are 16-bit word machines versus 24-bit word for the DIS (XDS 920). A special hardware interface device was installed between the DIS and the star switch controller to convert from 24-bit to 16-bit words, and vice versa, and to speed up access time for interfacing with the star switch controller. To accommodate interfaces with the new computers and new protocol and timing requirements with the star switch controllers, significant software changes were required in the DIS. Additionally, the structure of the monitor data parameters was either new or significantly modified from that which previously existed.

Another interface change, from the Mark III-75 to Mark III-78 configuration, was implemented for the DIS. The interface with the GCF high-speed data circuit, for receiving and sending data from and to the NOCC, changed. The DIS to GCF interface for the Mark III-78 system is via the star switch controller. The GCF has implemented a computer, the Communication Monitor Formatter (CMF), at each DSS. The DIS generates high-speed data blocks, consisting of station monitor data, and provides the data to the CMF via the star switch controller. The data are multiplexed with other systems data (e.g., telemetry) onto the high-speed data line for transmission to NOCC. The DIS receives control data from the NOCC via this same interface.

## B. Station Monitor and Control Console

The station monitor and control (SMC) console has been provided as part of the Mark III-78 system configuration. The SMC console provides a central control and monitor operator's position for some of the subsystems at the DSS (other subsystems are controlled via another input-output device — see Subsection C, below). The SMC consoles are currently in limited use in the Network; however, work is in process to make them a more useful operational tool. Additional station subsystems are being modified to permit central station control from the SMC consoles.

## C. Special Input-Output Terminal

With the implementation of new computers in the Command, Telemetry, Tracking, and Radio Science Subsystems (and the CMF at the DSS), a special terminal was installed as a central DSS input-output device. It consists of four elements:

two keyboard-CRTs, a hardcopy printer, and "host" software capability. The keyboard-CRTs and printers interface with the host software (which runs in any of the new computers), and the host software then interfaces with all of the new computers via the star switch controller. In this manner, the new computers can be centrally controlled and monitored.

# III. Ground Communications Facility

Significant implementation in the GCF has occurred over the last two years. Concurrent with these changes, the GCF Monitor and Control Subsystem (GMC) has undergone major changes. At JPL in the GCF central communications terminal, the Central Communications Monitor (CCM) computer has been implemented to provide central facility monitor capability. The CCM receives GCF monitor data from two sources: (1) from each Deep Space Station CMF, and (2) from equipment located at the central communication terminal at JPL.

At the DSS, each CMF monitors the status of the GCF equipment and provides periodic status messages, via high-speed data circuit, to the central communications terminal CCM. It should be noted that the control of the CMF is from the central input-output terminal at the DSS (see Subsection II-C, above).

Within the central communications terminal, the CCM monitors the status of the GCF equipment. Major implementation has occurred within the central communications terminal over the past two years. Computers, as part of the GCF high-speed subsystem, have been implemented to allow message switching and error detection-correction. These functions are being accomplished in the high-speed switch (HSW) and the error detection-correction (EDC) assemblies. The new computers interface to the CCM via the standard DSN computer interface — the star switch controller.

# IV. Network Operations Control Center

The NOCC Monitor and Control Subsystem (NMC) provides the processing capability for central network monitor and control. Although no major hardware changes have occurred in the NMC, significant software changes were required due to major modifications in the DSS and GCF. The high-speed data messages received from the DSS underwent significant modification due to the implementation that occurred there. Still to be implemented in the NMC is the ability to process GCF monitor data from the CCM. When this has been accomplished, the DSN Monitor and Control System, Mark III-78 configuration will be complete.

DSS SUBSYSTEMS

TELEMETRY
(2)

COMMAND
(2)

TRACKING

RADIO
SCIENCE

STAR SWITCH CONTROLLER (2)

MONITOR AND CONTROL

HOST SOFTWARE ◄► I/O TERMINAL

DIGITAL INSTRUMENTATION SUBSYSTEM

STATION MONITOR AND CONTROL CONSOLE

NON-COMPUTERIZED SUBSYSTEMS

RECEIVER-EXCITER

MICROWAVE

ANTENNA MECHANICAL

FREQUENCY AND TIMING

TRANSMITTER

NOCC SUBSYSTEMS

DISPLAY

MONITOR AND CONTROL

TELEMETRY
(3)

TRACKING
(2)

TEST AND TRAINING
(2)

SUPPORT
(2)

COMMAND

SPARE

STAR SWITCH CONTROLLER (3)

DSN MONITOR
AND CONTROL
MAJOR ELEMENTS

NOCC COMMUNICATIONS SUBSYSTEM

NCE ►◄ NLP

HIGH-SPEED SUBSYSTEM

HSW    EDC    CMF

CENTRAL COMMUNICATIONS MONITOR

GCF SUBSYSTEMS
► WIDEBAND
► VOICE
► TELETYPE

NCE - NOCC COMMUNICATION EQUIPMENT
NLP - NETWORK LOG PROCESSOR
HSW - HIGH-SPEED SWITCH
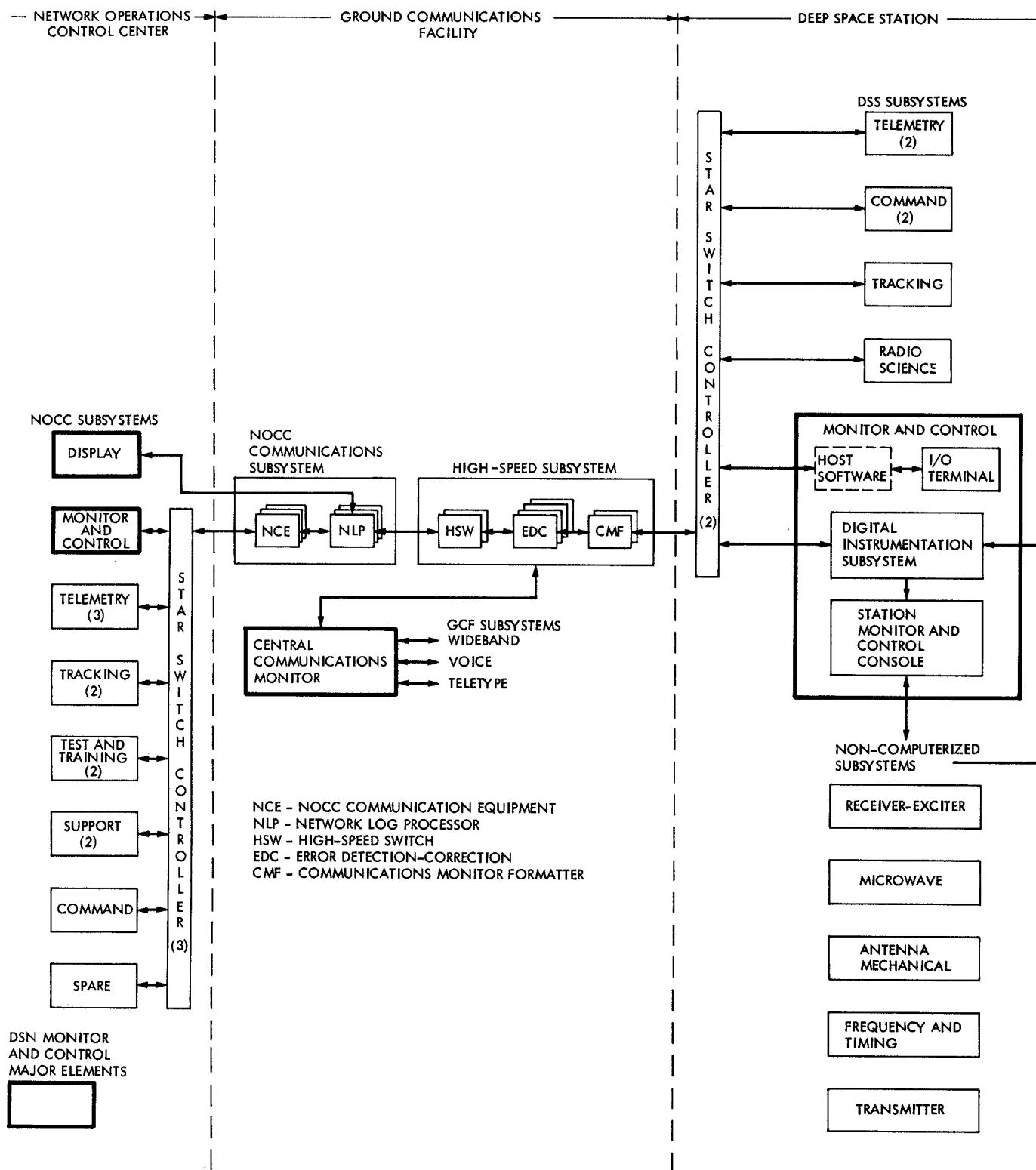EDC - ERROR DETECTION-CORRECTION
CMF - COMMUNICATIONS MONITOR FORMATTER

Fig. 1. DSN Monitor and Control System, Mark III-78