Networks Consolidation Program System Design

E. C. Gatz
TDA Engineering Office

This article describes the general system design for the Mark IV-A Deep Space Network to be implemented in the Networks Consolidation Program. The arrangement and complement of antennas and the list of subsystem equipment at the Signal Processing Center are described.

I. Introduction

The description of the Networks Consolidation Program (NCP), its history, management planning, and system design approach is given in Ref. 1. The objective of the program is to develop a single cost-effective network of ground tracking stations for communicating with interplanetary spacecraft and with earth-orbiting satellites not served by the Tracking Data Relay Spacecraft System (TDRSS). In the process of this development, it is expected to reduce operations costs and to provide increased antenna aperture on the ground for greater data return for deep space missions.

The current Deep Space Network, called Mark III, will therefore be reconfigured for these objectives, as well as to include other planned improvements. This reconfigured network will be known as the DSN Mark IV-A. The current plan is to perform this reconfiguration in 1983 and 1984 with completion in the middle of 1985.

II. Mark IV-A Network Configuration

The new network configuration is shown in Fig. 1. It consists of five antennas and Signal Processing Center (SPC) at each of three Deep Space Communications Complexes: Goldstone, California; Madrid, Spain; and Canberra, Australia. Communication facilities to connect these complexes to the Network Operations Control Center are included.

At each complex, the antennas are to be colocated within 1 or 2 kilometers in order to ease operations and maintenance and to enhance the capability of arraying multiple antennas. Each antenna has some locally mounted equipment: antenna drive, low-noise amplifier, receiver front-ends, and transmitters. However, the bulk of the antenna-associated equipment: antenna controller, microwave instrumentation, transmitter controls, etc., is located at the SPC. The SPC also includes telemetry, command, radio metric, and radio science

processing equipment, as well as other associated control and processing equipment.

III. Antennas

Each complex is planned to have five antennas, configured as follows:

(1) 64-Meter. This is the existing antenna configured for S-band transmission and reception and X-band reception. This is the prime antenna for deep space communications and for radio science and Very Long Baseline Interferometry (VLBI) applications.

(2) 34-Meter Transmit/Receive. This is the existing 34-meter antenna at each complex, configured for S-band transmission and reception and X-band reception. It is used for all deep space applications and is planned for support of High Earth Orbiters also.

(3) 34-Meter Listen-Only. This will be derived by enlarging and moving the DSN 26-meter antenna at each complex. These antennas will be equipped for X-band only and will be used in array applications.

(4) 34-Meter Listen-Only. This will be derived by enlarging and moving the Ground Spaceflight Tracking and Data Network (GSTDN) 26-meter antenna at each complex. It will be configured for both X-band and S-band reception and will be used for both deep space and High Earth Orbiter reception and for VLBI applications.

(5) 9-Meter. The existing GSTDN 9-meter antennas will be relocated and used for S-band transmission and reception in support of High Earth Orbiters.

IV. Signal Processing Center

A simplified block diagram of a Signal Processing Center is shown in Fig. 2. This shows the general subsystem complement. Detailed configurations and connections will be described in later articles. The SPC is configured to support operation of each antenna individually, or to array any combination of the large antennas. Two subarrays can be supported.

As indicated, antenna control, receiver/exciter and radio metric tracking subsystem equipment is associated with each antenna as appropriate. Only transmitting antennas have exciters and tracking equipment. The Telemetry, Command, and Monitor and Control Subsystems are each organized into four groups. Each group can be independently assigned; the groups are thus assigned to form up to four "links." Each "link" has the necessary equipment to support one spacecraft mission, with receiver, antenna, tracking, command, and telemetry equipment. The link can handle a single antenna or an array. Each link is controlled by a single operator stationed at the link Monitor and Control Console. The link assignments, including the antenna and associated equipment, are performed by the complex Monitor and Control according to an established schedule. Other subsystems provide test support, technical facilities, frequency and timing, maintenance, and radio science support. Details for the SPC System configurations will be presented in future articles.

V. Current Design Work

This article has outlined the system design for the Mark IV-A Deep Space Network. Design work is continuing on the details of connection and control of all elements and on antenna and SPC floor plans and equipment layouts.

Reference

1. Yeater, M. L., Herman, D. T., and Sanner, G. E., "Networks Consolidation Program," in *The Telecommunications and Data Acquisition Progress Report 42-59*, July and August 1980, p. 107-120, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1980.

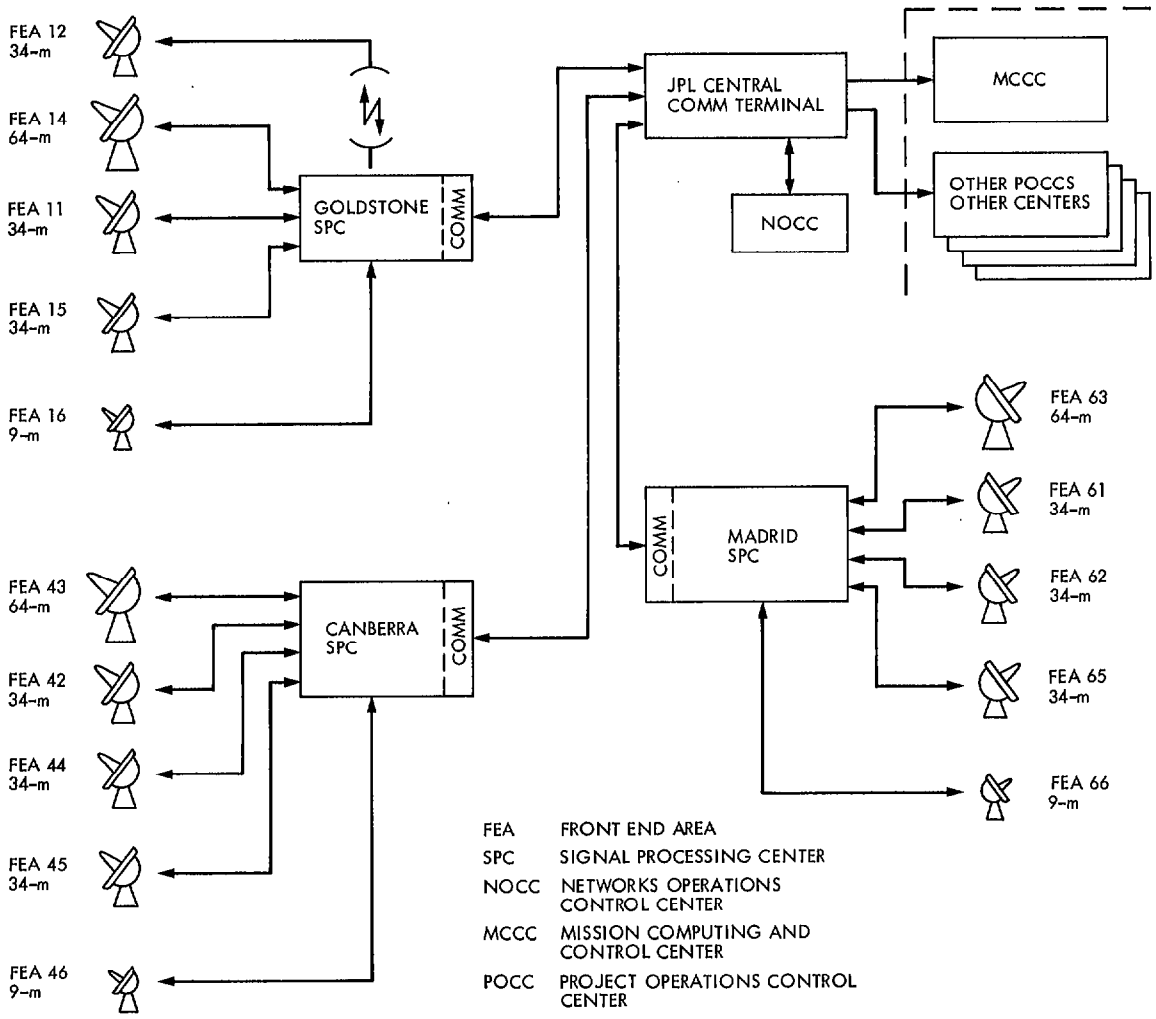

Fig. 1. Mark IV-A Deep Space Network Configuration

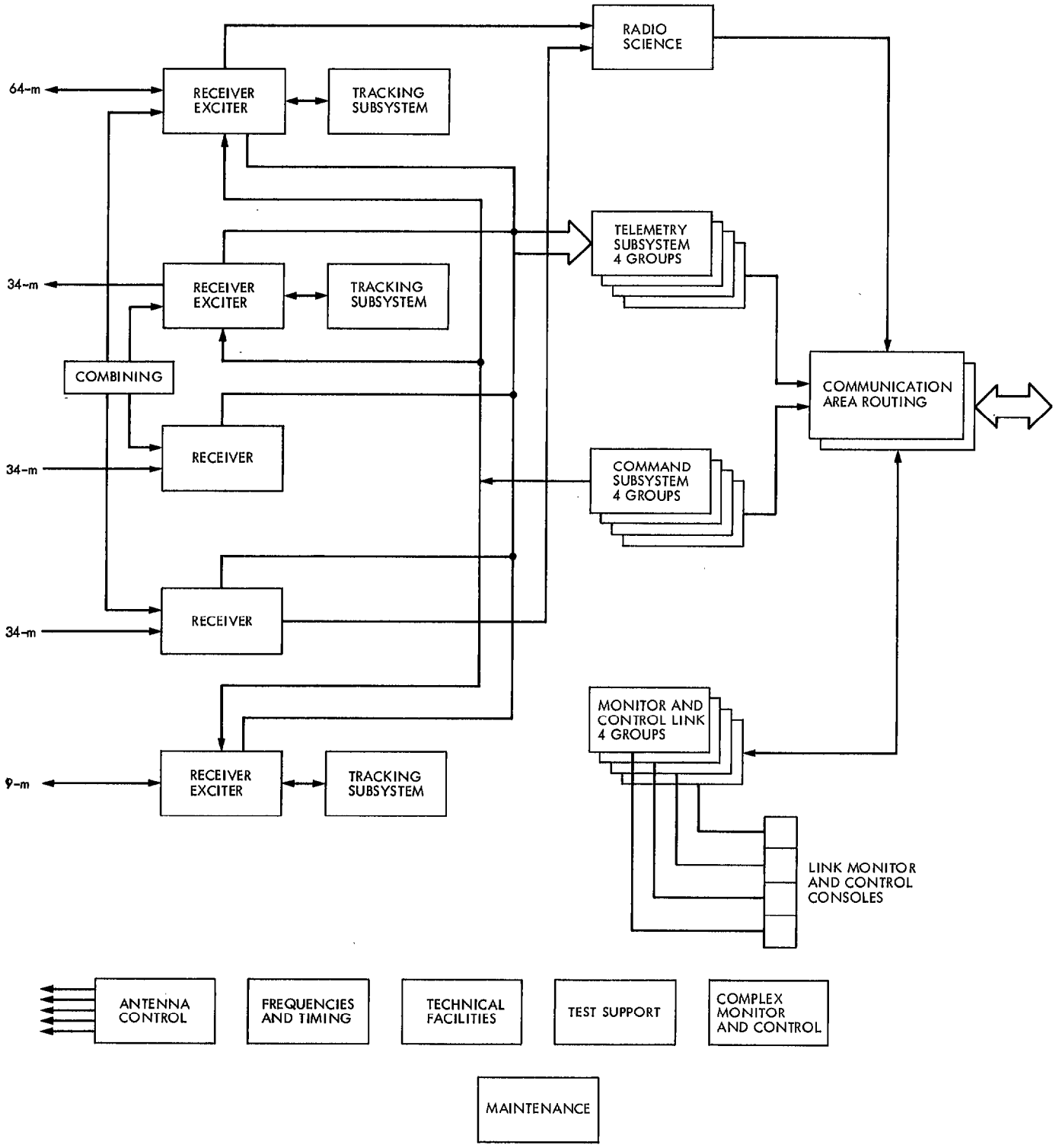

Fig. 2. Signal Processing Center, simplified block diagram