GCF Mark IV Development

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This article provides an overview of the Mark IV GCF as it is being implemented to support the Network Consolidation Program.

I. Introduction

The Network Consolidation Program (Ref. 1) requires that the Ground Communications Facility (GCF) (Ref. 2) be upgraded in order to support the mission set of the eighties. The key characteristics of the GCF do not change appreciably in the Mark IV DSN (see Figs. 1-3). The changes made are in the area of increased capacity rather than changing characteristics. Common carrier circuits continue to be the medium for data transfer. The message multiplexing in the Mark IV era differs from the Mark III era in that all multiplexing will be accomplished in a GCF computer under GCF software control vs hardware multiplexing at the NASA Communications (NASCOM) level, similar to the multiplexing currently done in the High-Speed Data Subsystem.

The Signal Processing Center (SPC) assemblies will be controlled and monitored by the SPC Monitor and Control Subsystem while the Central Communications Terminal (CCT) equipments will be monitored and controlled by the GCF Monitor and Control Subsystem. The computers required for the Mark IVA will be composed of the Modcomp II/25 computers currently in use by the GCF; their functions as redefined will require software changes.

II. Digital Communications Subsystem

The Digital Communications Subsystem performs the exchange of digital data between the SPC and JPL using common carrier circuits. Because lease costs of circuits are high, block multiplexing is used to allow sharing of the lines between projects. This subsystem also does data routing either to the proper SPC or the proper user. To maintain high-quality communication, error correction by retransmission will be used in the 56-kb/s duplex line, using an algorithm similar to the current algorithm used with high-speed data. Original Data Record (ODR) data logging will be accomplished at the SPC. At the CCT, the capability for front-end recording will be continued. This subsystem interfaces with the Network Operations Control Center (NOCC) (for which it accomplishes data routing) and with the Mission Control and Computing Center (MCCC), the Remote Mission Operation Center (RMOC), and Project Operation Control Centers (POCCs). This subsystem also routes data to the Data Records Subsystem (see Fig. 4).

The Digital Communications Subsystem is composed of five subassemblies.

A. Area Routing Assembly (ARA)

The ARA at each SPC is composed of two identical computers: one for prime and one for backup. The two computers are to be converted Communication Monitor and Formatter Assembly (CMF) computers (Fig. 5). The ARA assembly will provide regulation and control of data transmission. It will provide routing of data received to the proper link at the SPC. Low-rate data will be multiplexed on the 56-kb/s duplex line. Data will be sent in 4800-bit blocks, though 1200-bit blocks will be available to the GCF users.

B. Station Digital Communications (SDC)

The SDC will consist of data transmission equipment including line interfaces, data sets, modems, NEDs, CBs, digital and analog test equipment, and patch facilities for trouble isolation as well as a front-end line interface between the actual data sets and NED appearances (see Fig. 6).

NASCOM Engineering will provide all data transmission equipment including data sets, modems, line interface circuits, and analog test equipment. The DSN/GCF demarcation point between the DSN/GCF Data Terminal Equipment (DTE) and the NASCOM Data Communications Equipment (DCE) will be at the digital interface to the data set or other such carrier equipment provided by NASCOM.

C. Central Digital Communications (CDC)

The CDC in support of Mark IV-A will consist of data transmission equipment including line interfaces, data sets, modems, NEDs, CBs, digital and analog test equipment and patch facilities for trouble isolation as well as front-end digital line switches between the actual Digital Service Units (DSU) and the NEDs (see Fig. 7).

NASCOM Engineering will provide all data transmission equipment, including data sets, modem, DSUs and common carrier interfaces associated with overseas SPCs. The DSN/GCF interface between the DSN/GCF DTE and the NASCOM DCE will be at the digital (V.35) interface to the NASCOM DCE provided by NASCOM.

As part of the CDC implementation, a new digital line switch will be provided to interface 56 kb/s and/or 224 kb/s lines from each of the SPCs. The switch will provide appropriate interface for 7.2 kb/s data sets as well as WBD (56 or 224 kb/s) line devices.

D. Error Correction and Switching (ECS) Computer

Four Operational ECS computers and one backup will be provided. They will be converted from the present four ECS computers plus one former CMF computer. The prime functions of the ECS computer are those of multiplexing, demultiplexing, error correction, and data routing (see Fig. 8).

E. Network Communications Equipment (NCE) Assembly

One operational NCE computer and one backup will be provided. They will be the present two NCE computers with minor modifications (see Fig. 9). The NCE serves to interface the Network Data Processing Area (NDPA) Real-Time Monitor (RTM) and support computers directly with the Digital Display Processors (DDPs) and with the outside world via wideband data lines (WBDL) to the ECSs. The NCE provides a communication link between the ECSs and the subsystems of the NOCC in the NDPA. It extends the GCF interface to the RTMs and the support processor.

III. Analog Intersite Communications

The GCF microwave presently on line at the Australian and Spanish locations will be decommitted on the completion of the front-end area (FEA) moves to the SPC locations. The radios currently in use between DSS 12 and DSS 11 will be reused (see Fig. 10). The radios at DSS 11 will be decommitted and reinstalled at SPC-10, and the antennas at DSS 12 will be reoriented as required; the DSS 11 antennas will be reinstalled at SPC-10. The multiplex and radio equipment will be configured in standard 8-foot open-channel racks (not cabinets) similar to the existing microwave racks. The additional equipment will be Collins 518-W radios and Collins MX 106 multiplex equipment. The existing path will require additional antennas to connect the additional radios.

The computers at FEA-12, being remote from SPC-10, connect to a LAN interface panel. The interface panel accepts data from the computers and forwards the data via microwave to a companion interface panel at SPC-10. The computer-generated data are reconstituted and forwarded to the SPC LAN. Transmission in the opposite direction is similarly handled. Dual LAN interface panels and microwave channels are used for redundancy.

The LAN interface panel will remote the LAN ports in the SPC to matching LAN ports available to FEA processors. The link will be via microwave and will utilize a 56 kb/s channel, full duplex. The Western Union microwave link (JPL-Goldstone) will be expanded to handle the Mark IV service.

IV. Voice Communication Assembly

The Mark IV voice assembly will be configured from the equipments currently used, namely the tactical intercom, comm junction module, and station voice switch assemblies. There will be no changes required at the JPL end (GCF-20) (see Fig. 11).

A new communication panel will be developed for use with the new SPC consoles. Because of the advanced age of the Tactical Intercom Assembly (TIC) panels, a new circuit board will be developed to bring the system more in line with current technology.

V. Teletype Communications Assembly

The Mark IV teletype assembly will be made up of the equipments as they are configured at the present time. There are two basic services provided:

(1) 110-baud service using teletype machines with the circuits routed by the NASCOM GSFC teletype (TTY) switch to the WCSC located at GCF-20. (This provides for normal administrative test message service.)

(2) 300-baud service, whereby the station personnel have access to the DSN data base located in the JPL Administrative Computer via an auto dialer located at GCF-20.

VI. Monitor and Control

One operational CCM computer and one backup will be provided. They will be the present two CCM computers, with minor modifications (see Fig. 12).

The GCF monitor and control subsystem is based in the CCM, whose major functions include the collecting, processing, and displaying of real-time status and performance of the GCF subsystems. The overall monitoring of the CCT will be accomplished via the CCM computer and its associated displays and via the central console. The CCM computer will provide monitoring of the status of all equipment of the GCF.

Computer status reports, which do not deal with configuration but primarily with GCF performance (error rates, traffic flow, etc.), are formatted and forwarded to the CCM as standard GCF data blocks. The CCM will provide displays by means of the Grinnel display converter and the TV switch.

A CCM line printer will be used for DRG IDR gap reporting and summary and post-pass histories. Labels for tapes from the ECS and DRG computers will be printed on label printer terminets. The summary for the data channels and status and alarm messages will be printed on the console terminet.

VII. Data Records Generator

Three operational DRG computers and one backup will be provided. They will be converted from the present DRG lineup. The chief function of the DRG is to provide IDRs that are recorded on magnetic tape. The program of the DRG is the only one that is mission-dependent (see Fig. 13).

The DRG software will check each data stream for correct SPC, spacecraft ID, UDT/DDT, gross data description (GDD), block serial number (BSN), block header time, and error status code. During the pass, the DRG will detect gaps and output real-time gap statistics. These data will normally be output on a CCM display, but may also be printed. At the end of a pass, the DRG outputs a complete IDR report including gap list, via the CCM.

References

1. Yeater, M. L., and Herrman, D. T., "Networks Consolidation Program," *TDA Progress Report 42-65, July and August 1981*, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1981.

2. Evans, R. H., "DSN Ground Communications Facility," *TDA Progress Report 42-65, July and August 1981*, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1981.

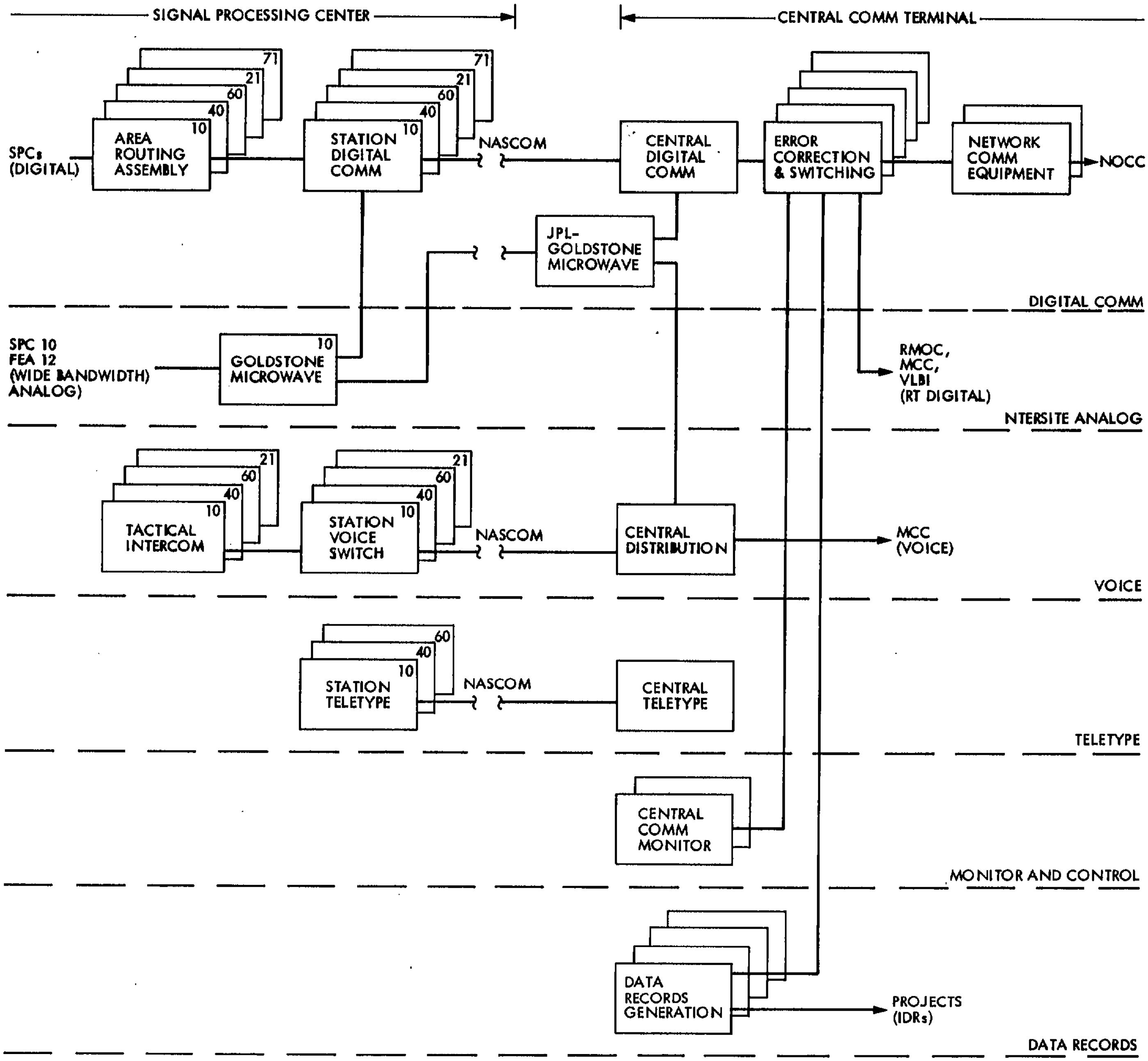

Fig. 1. Mark IV-A era GCF subsystems

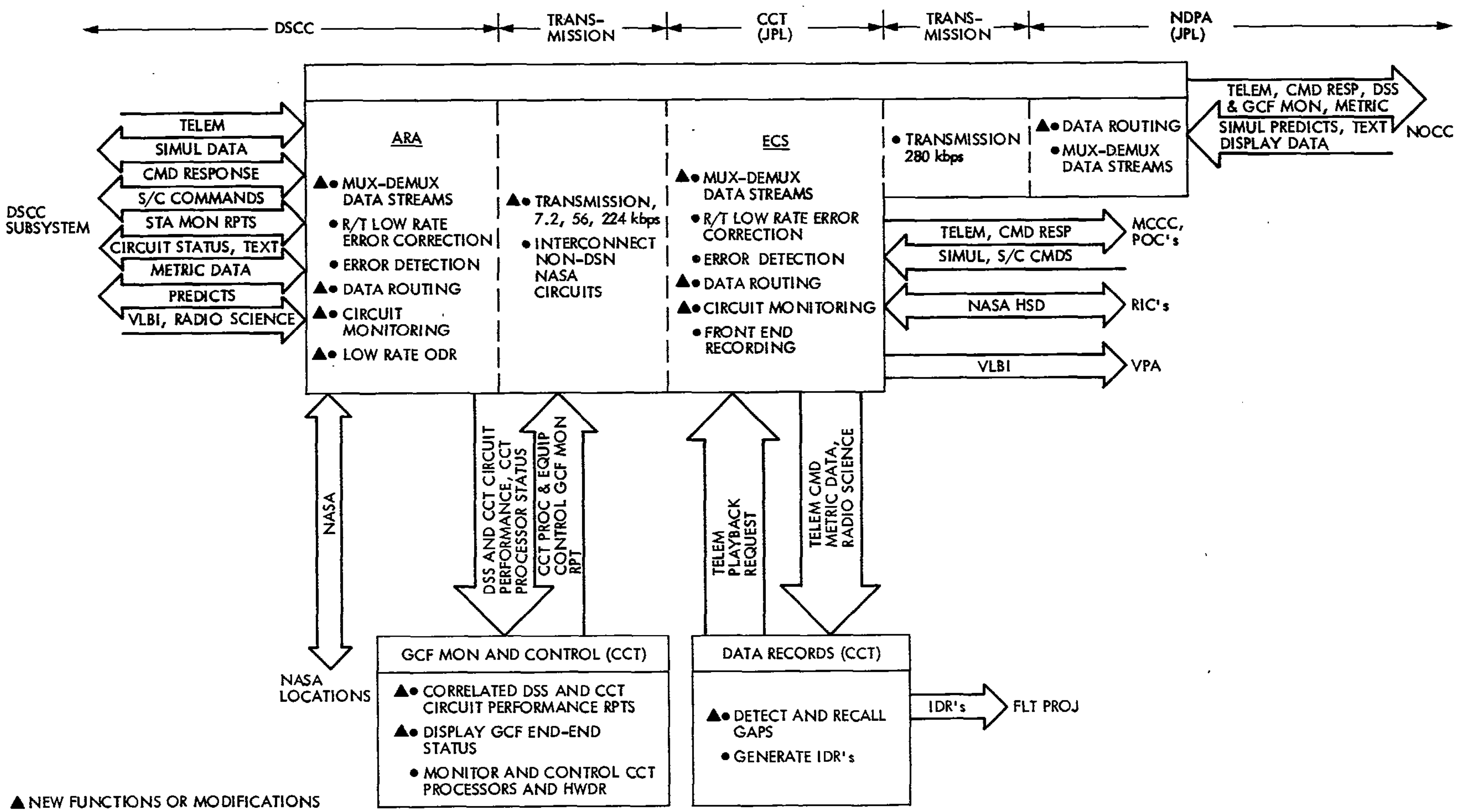

Fig. 2. Mark IV-A end-to-end digital communications, data record, monitoring, and network communications equipment functions and interfaces

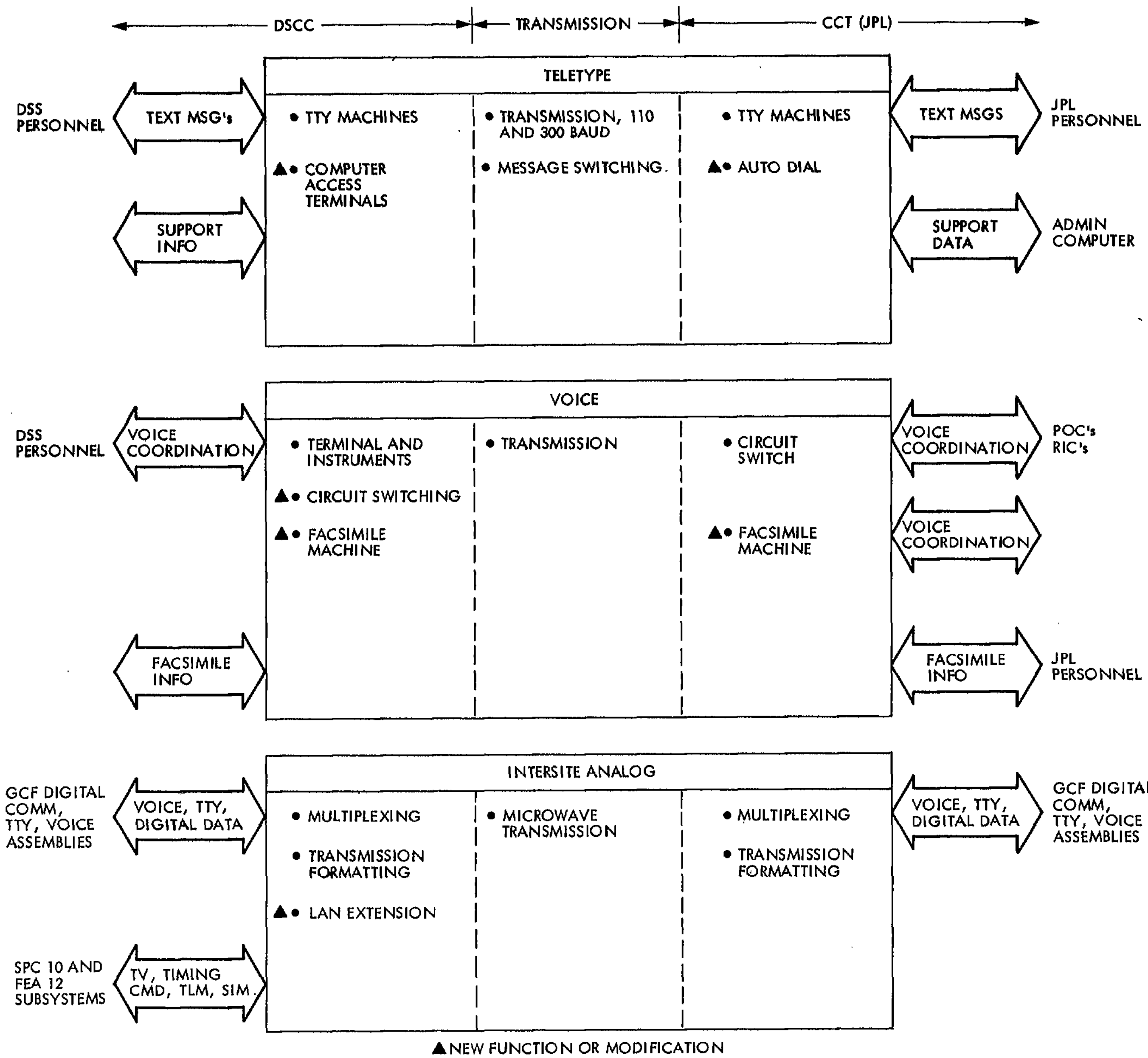

Fig. 3. Mark IV-A end-to-end teletype, voice, and intersite analog functions and interfaces

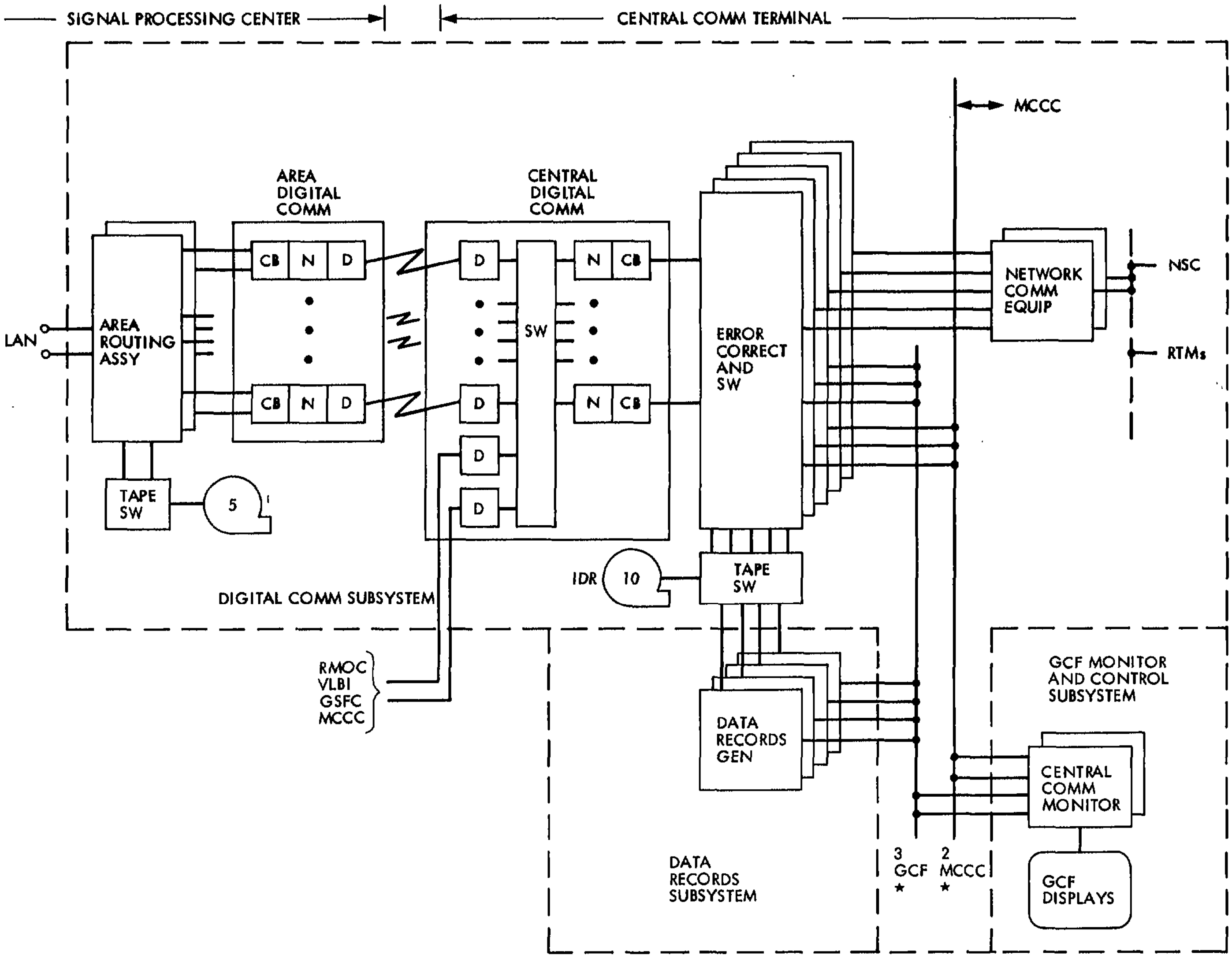

Fig. 4. Digital communications subsystem overview of GCF digital configuration

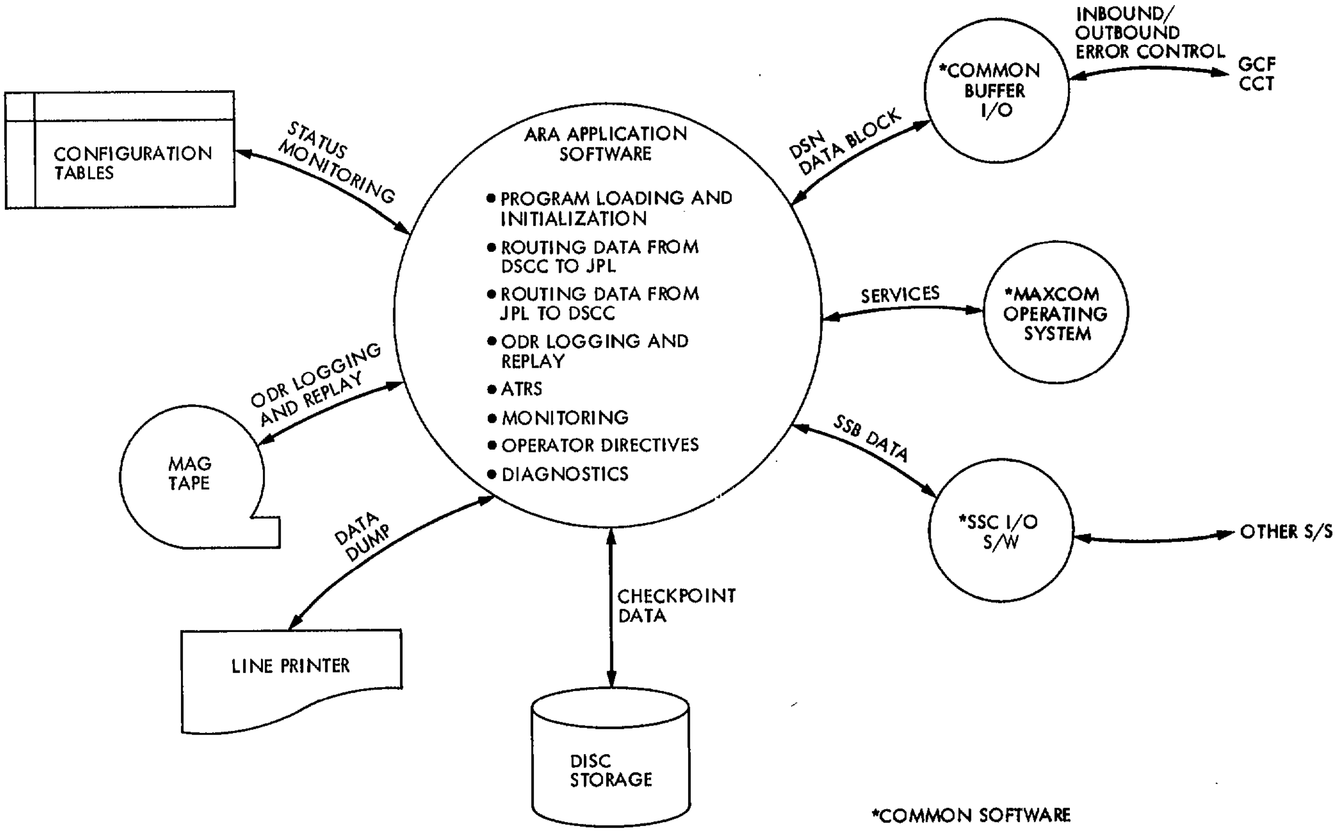

Fig. 5. ARA software functions and interfaces

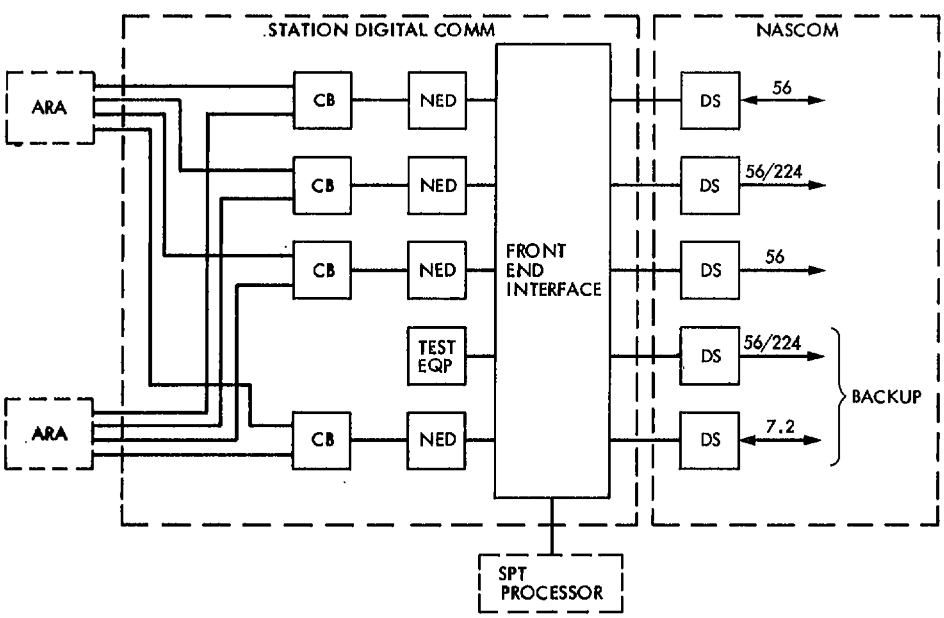

Fig. 6. Data transmission, station digital communications

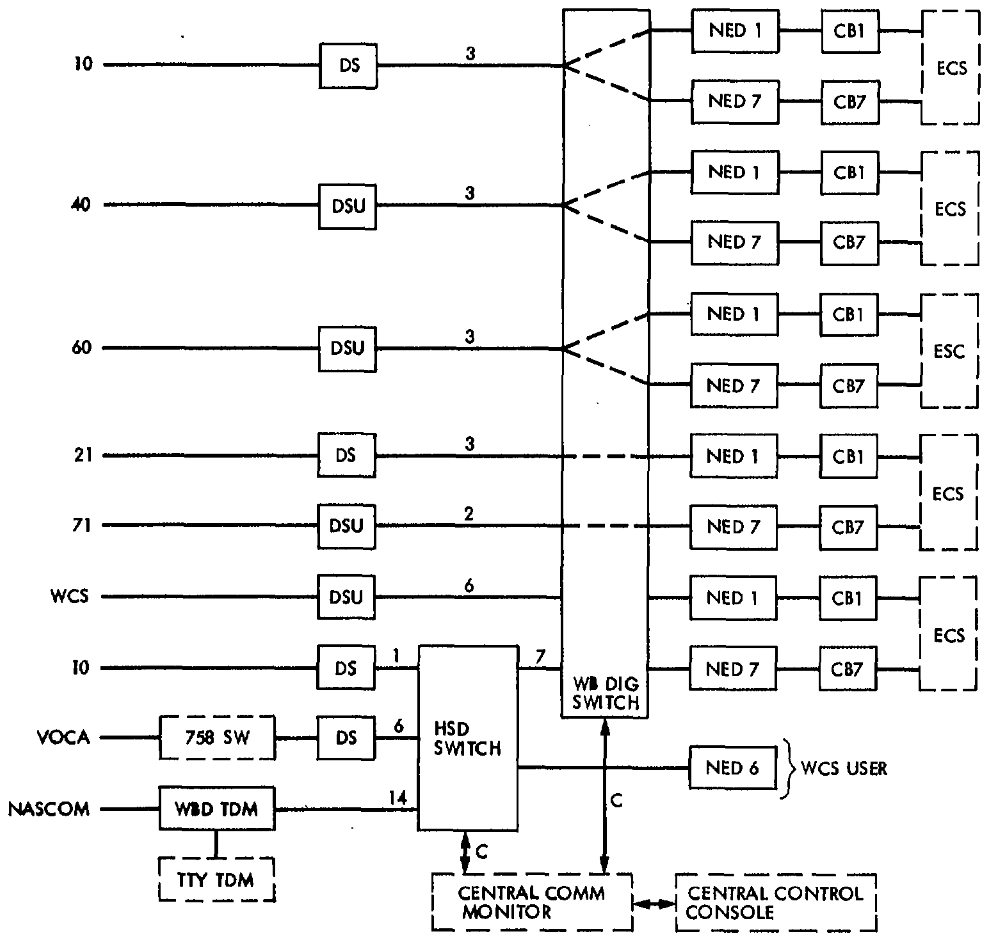

Fig. 7. Data transmission, central digital communications

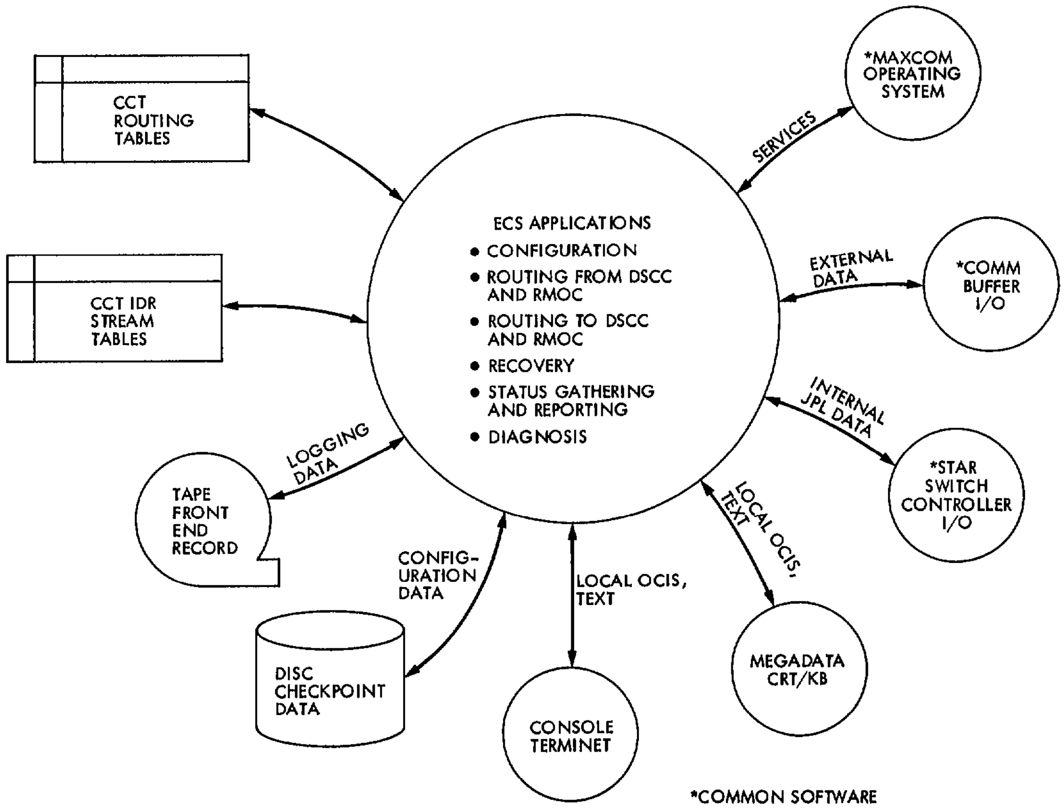

Fig. 8. ECS software functions and interfaces

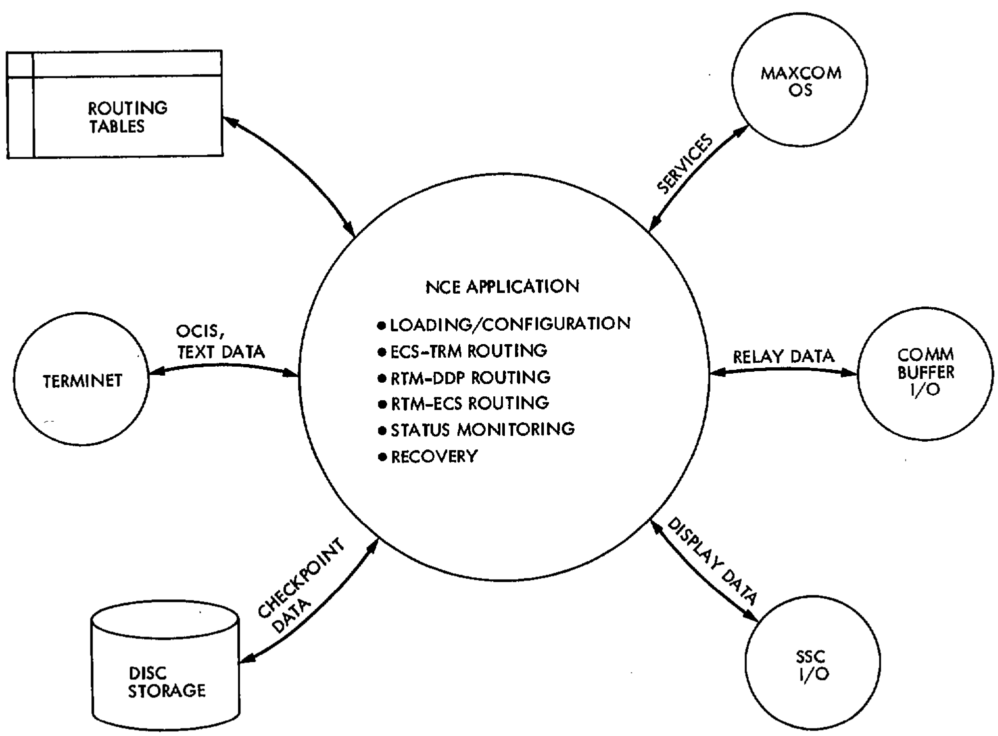

Fig. 9. NCE software functions and interfaces

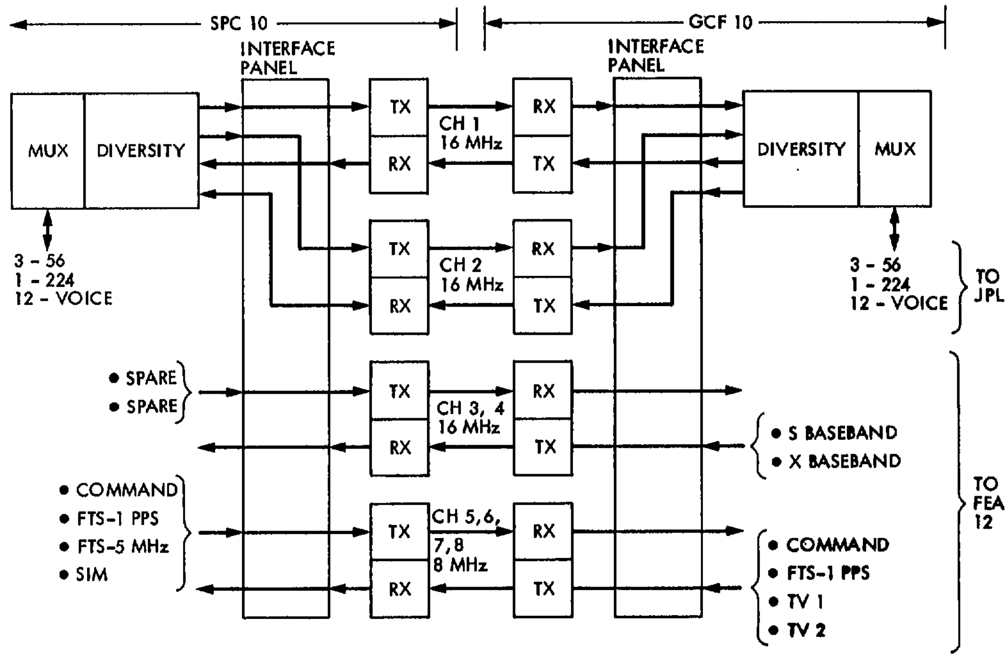

Fig. 10. Intersite microwave configuration, general design

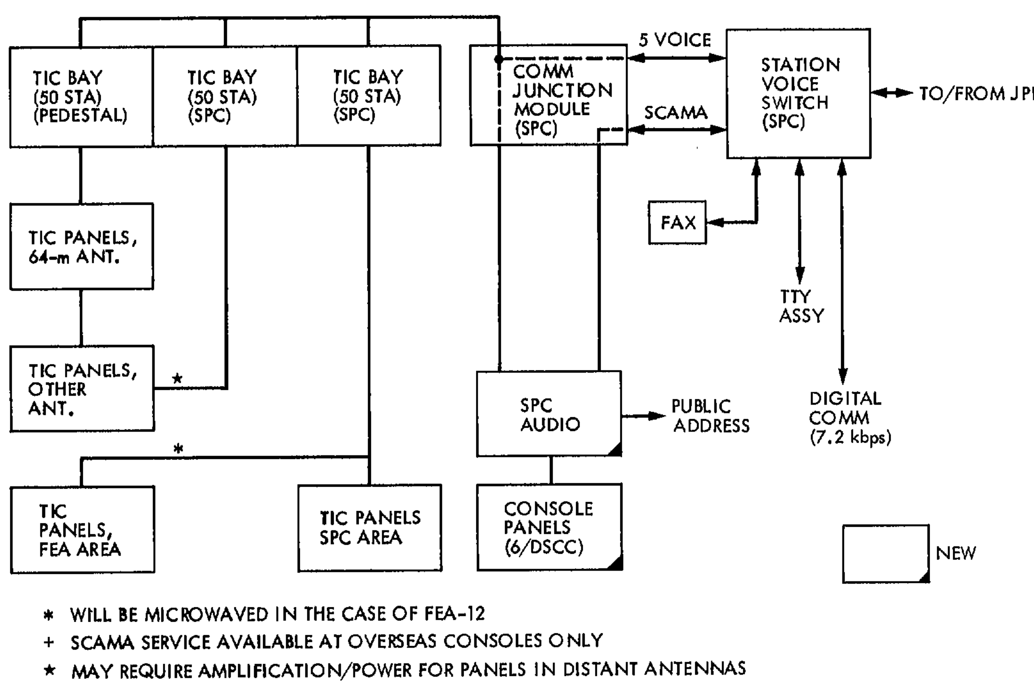

Fig. 11. DSCC voice, general design

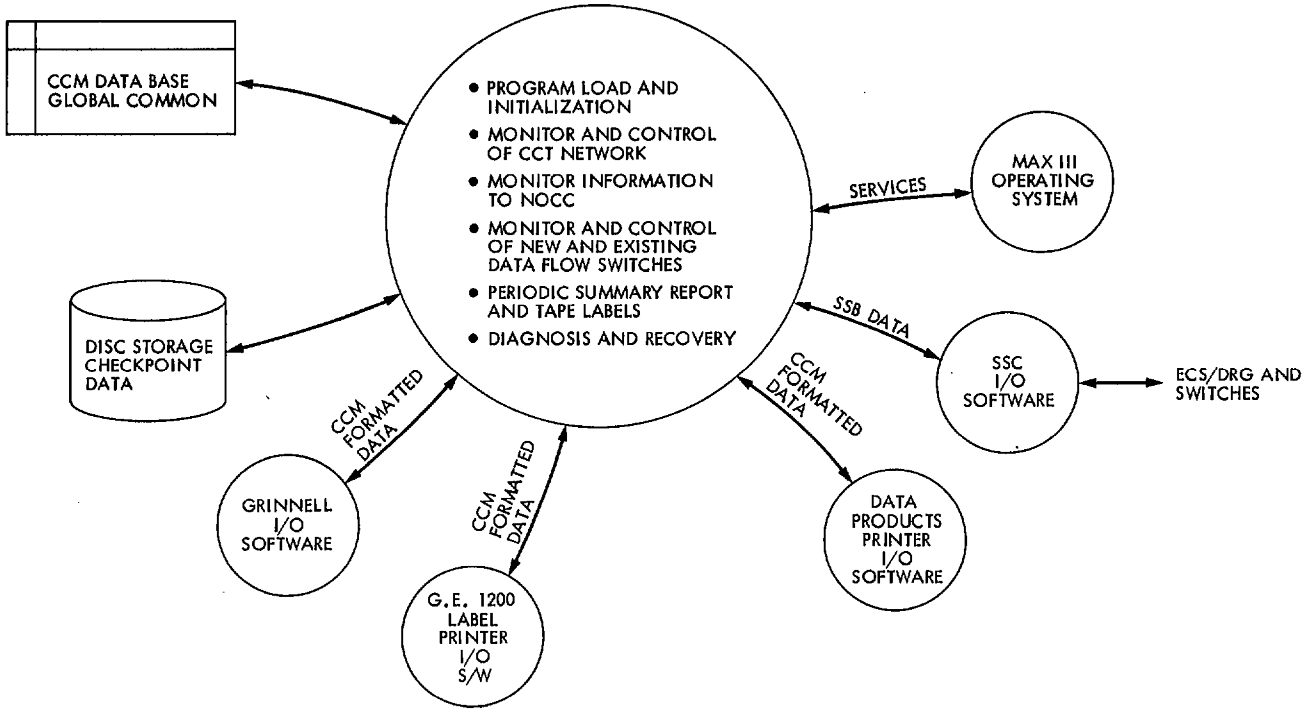

Fig. 12. CCM software functions and interfaces

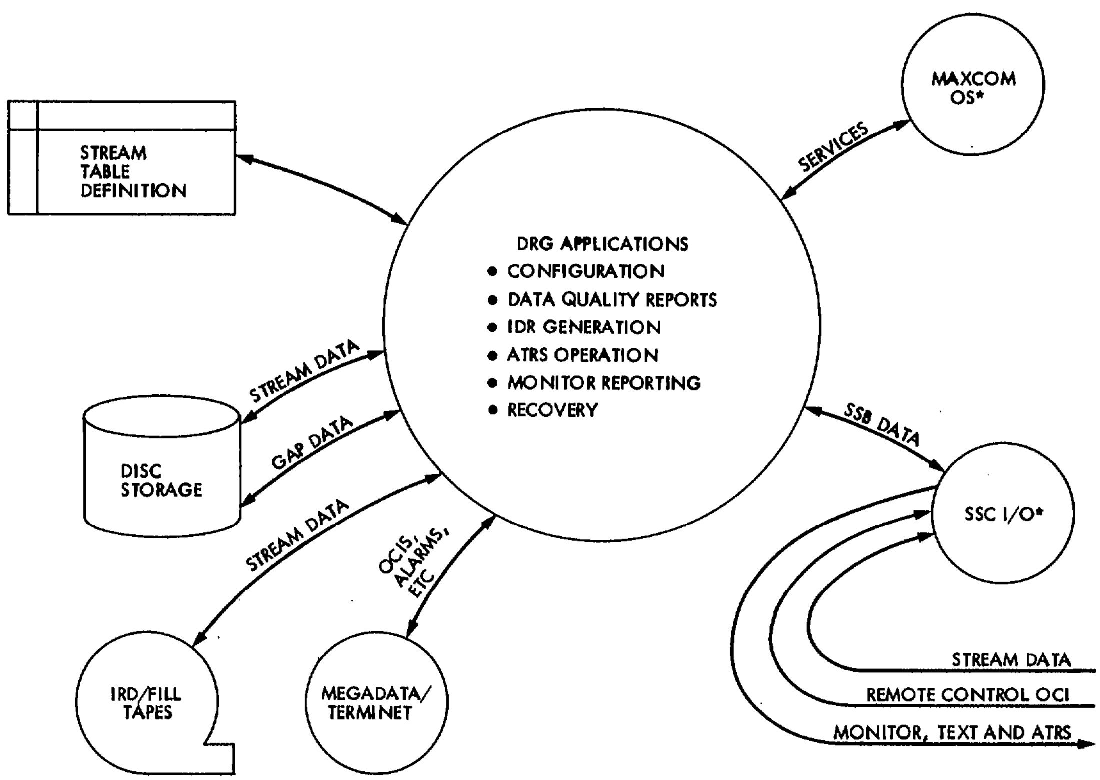

Fig. 13. DRG software functions and interfaces