

GCF Reconfiguration of the Goldstone DSCC Microwave Terminals for 50-kbit Data Transmission

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This article covers the reconfiguration of the Goldstone Deep Space Communications Complex area microwave terminals at the Mars Deep Space Station and the Goldstone area communications terminal for the transmission of dual 50-kbit digital data streams between the two locations.

I. Introduction

This article describes the reconfiguration of the Goldstone DSCC microwave terminals required for the transmission of dual 50-kbit/s digital data streams between DSS 14 and the Goldstone area comm terminal (ACT) located adjacent to DSS 12. This article is an amplification of two earlier articles (Refs. 1 and 2).

Requirements for a 50-kbit/s data transmission capability of the GCF were derived from the GCF functional design for 1971–1972 (Ref. 3). The GCF functional design specifies two 50-kbit/s data streams between the SFOF and DSS 14, one stream being a backup to the other.

II. Background

The current microwave transmission capability between DSS 14 and the Goldstone area comm terminal is entirely JPL owned and operated. That portion of the overall DSS 14-to-SFOF transmission capability existing between

the Goldstone area comm terminal and the SFOF is owned and maintained by Western Union and leased to JPL. The problem of how to best use the available microwave baseband spectrum between DSS 14 and the area comm terminal for dual 50-kbit streams was thus a portion of the development effort.

There are five duplex microwave channels between DSS 14 and the area comm terminal. Each of these channels has a 10-MHz baseband bandwidth. The equipment manufactured by Collins Radio Corp. of Dallas, Texas, is an off-the-shelf system and is designed primarily for intercity telephony or broadcast quality television. This particular group of equipment has been installed at the Goldstone DSCC since 1966 and is used for numerous functions such as:

- (1) Multiple-mission support, wherein the DSS 14 antenna is used to track a spacecraft and the resultant DSS 14 data is forwarded to data reduction equipment at another station via the microwave channel.

- (2) GCF voice circuits between the two stations.
- (3) GCF teletype circuits and high-speed data circuits between the two stations.

Included as a portion of each terminal is a standard frequency division multiplex (also manufactured by Collins Radio). Prior to the requirement of 50-kbit data between DSS 14 and the ACT, this multiplex equipment was used to pass several operational voice channels. The GCF recognized the requirement to transmit the following information between the two stations, utilizing as few microwave channels as possible and still be guaranteed of high reliability:

- 9 Channels of voice
- 2 Channels of 4800-bit/s high-speed data
- 6 Channels of 75-bit/s teletype
- 2 Channels of 50-kbit/s wideband data
- 1 Channel of 1 pulse/s intersite timing

The frequency division multiplex (Collins MX-106) was originally purchased as a basic 60-channel (voice) system, wired for 24 channels and equipped with 12 channels. In the world of commercial communications, 12 voice channels can be multiplexed into a 48-kHz-wide signal, occupying the basic spectrum of 60 to 108 kHz. Channel modems perform the basic modulation of voice signals in the 0 to 4 kHz portion of the spectrum to 60 to 108 kHz portion of the spectrum. Four kHz is allocated for each of these modems, the twelve channels thus forming a "group" 48 kHz wide. As earlier stated, only one group initially existed (i.e., 12 voice channels) but the wiring, module space, power, etc., provided for future expansion of the multiplex.

The General Electric TDM420 modems used to translate the GCF 50-kbit conditioned signal to that portion of the baseband spectrum normally occupied by a group of 12 voice channels, generate and accept a vestigial sideband signal occupying 60 to 108 kHz in the baseband spectrum.

III. Implementation

Initially it was planned to place the vestigial sideband signal directly on the microwave baseband, thus dedi-

cating two 10-MHz-broad channels for carrying the two 48-kHz 50-kbit signals. Further analysis led to the conclusion that the available microwave channels would best be utilized by concentrating as many GCF signals onto one broadbanded channel as practicable.

Investigation of the available hardware at each terminal showed the following:

- (1) An existing baseband combiner which could automatically and instantly switch between two microwave receivers.
- (2) A radar multiplex which could be used to pass fast risetime pulses in the 4 to 6.5 MHz portion of the available baseband spectrum (such as 1-pulse/s timing).
- (3) Resistive splitters allowing a single source to drive two microwave transmitters simultaneously.
- (4) Available carrier source already installed in the MX-106 multiplex.

It was thus determined that the most economical and reliable usage of the microwave would be to stack all known circuits onto two microwave channels and arrange the receivers at each end to feed the GCF equipment via the baseband and combiner mentioned earlier. The net result of the diversity arrangement is one 10-MHz full duplex (both directions simultaneously) diversity video channel carrying the following signals:

Secondary 50 kbit	60 to 108 kHz
12 (each) voice circuits ¹	408 to 456 kHz
Prime 50 kbit	456 to 504 kHz
Continuity pilot carrier	6.2 MHz
Time pulse and time pulse verification	4 to 6.5 MHz

To obtain the additional 48-kHz-wide group for the second 50-kbit channel it was only necessary to purchase two each group modulators and demodulators and plug them into prewired mounting positions at each station.

Figure 1 shows the multiplex and diversity arrangement at both DSS 14 and the ACT. Both stations have

¹Each voice circuit can pass either voice, 4800-bps high-speed data, or as many as 18 teletypewriter circuits.

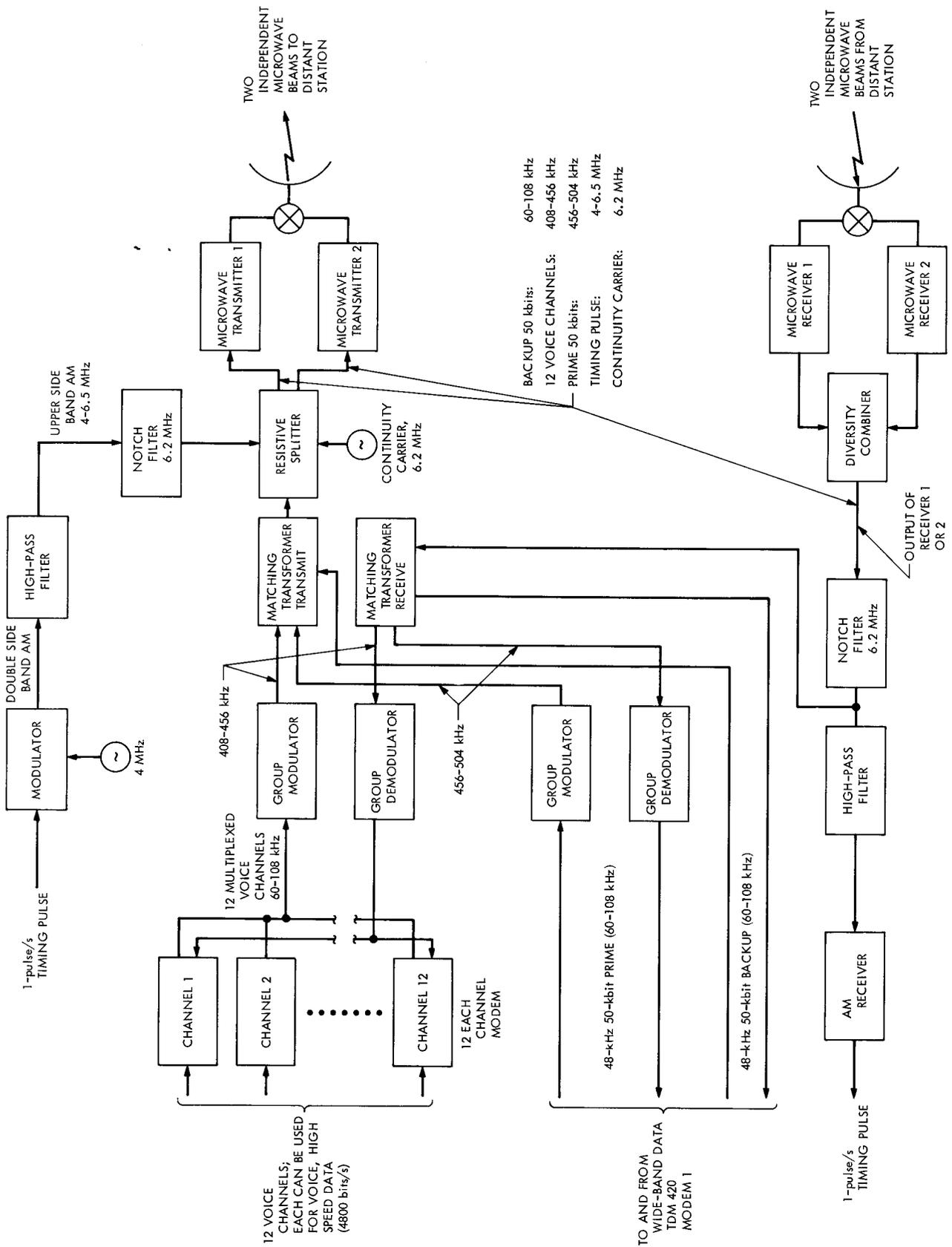


Fig. 1. Microwave terminal configuration block diagram, DSS 14 and area comm terminal

an identical arrangement, the only difference being the operating frequency of the microwave transmitters and receivers.

IV. Conclusion

In response to the requirements put forth in the 1971-1972 GCF functional design for the 1971-1972 wideband

system, certain rearrangements were made to the existing area microwave between DSS 14 and the ACT to take advantage of the wideband characteristics of the microwave channels. Signals from all GCF systems—voice, high speed, teletype, and wideband—may now be placed on a single diversity channel. Additionally, the GCF has ample bandwidth on this one channel for future expansion.

References

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