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WIDE-BAND CABLE SYSTEMS AT SLAC*

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Introduction

SLAC's first cable TV system was installed in 1979 to remotely monitor a narrow pulse which was generated in the west end of the klystron gallery. This cable (installed without amplifiers) was followed by a broadband system around the Positron-Electron Storage Ring (PEP). The latter cable is used as a one-way (broadcast) information network from the control computer to the experimenters located around the ring. It carries two video channels and one 9600 baud data channel.[1]

When Stanford Linear Collider (SLC) experimental work started at the west end of the accelerator, the original 1979 cable was upgraded to a bidirectional system so that 2 MBaud point-to-point data and several video and 9600 baud channels could be transmitted. A localized control area was located at the west end and a temporary main control area was located in the Central Laboratory near the east end of the two-mile accelerator. The PDP11/780 VAX control and monitoring computer was temporarily located in the Central Laboratory area also. The previously installed cable system was the only reasonable way to transmit this mixture of information. After this cable was upgraded, computer generated displays were sent to our klystron gallery maintenance area and to an adjacent klystron test area.[2]

Linear Collider Broadband Cable

The implementation of the SLC requires a complete upgrading of the accelerator control system. The system is based on a distributed processing configuration using a PDP11/780 VAX in the Main Control Center (MCC) and Intel single-board computers in a multibus configuration along the accelerator. The high-speed data linking is supplied by a 1 MBaud Time Divi-' n Multiple Access (TDMA) Network. The same cabl. is used to provide video, low-speed data, voice and high-speed point-to-point data services. The transmission system will utilize a wide-band midsplit cable facility to collect and distribute signals to all parts of the network.

Cable Configuration

We have chosen to use a midsplit configuration since it provides roughly equal spectrum above and below the filter split. The low band occupies 5 to 120 MHz while the high band occupies the 160 to 300 MHz spectrum. The midsplit system permits low-band signals to travel in one direction while high-band signals are sent in the opposite direction on one cable. This bidirectional property is obtained by splitting the two bands and amplifying each separately. Provision for cable equalization and adjustable gain are an integral part of each amplifier. The two bands are then combined on the coaxial cable and travel to the next amplifier in the chain. Almost all low-band signals will be up-converted to high band so that signals can be transmitted from anywhere and can be received anywhere along the cable. All low band signals go to the injector were up-conversion takes place. The high frequency signals are then sent back down the cable (see Fig. 1). This method requires twice the bandwidth, but we feel the flexibility warrants this mode of operation. The cable is now approximately three miles in length extending from the Central Laboratory, through the Computer Building,

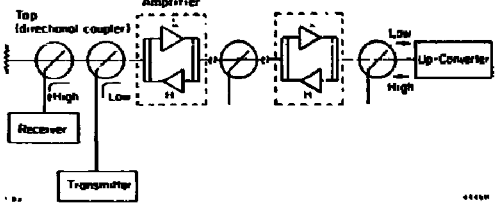

Fig. 1. Basic signal flow on the cable.

through part of the PEP tunnel to th PEP control room and finally through the klystron gal ry to the injector area. Taps are provided at convenie points along the accelerator. Several Console-On-Wheels (COWs) are provided so that the accelerator operation can be accomplished anywhere along the cable in contrast to the present system where control is only possible in the main control room and at three other fi d locations along the accelerator.

We will provide the following serv es on the cable (see Fig. 2):

1. Four 6 MHz video channels (camera or mputer generated signals).
2. Forty channels of voice (CB sets for intercoms).
3. Two, 6 MHz 1 MBaud channels (monitoring and control of the accelerator).
4. One, 6 MHz of Sytek System 20, 9600 baud channels (terminal to VAX). This service will support twenty channels with up to two-hundred nodes per channel.
5. Six, 6 MHz point-to-point 2 MBaud channels (pattern and fast feedback loops).

The spectrum will also contain a pilot carrier so that amplifier levels can be read by the VAX in case of amplifier or cable failure. This status information will be sent back by a separate two-pair cable and will be continuously available to the Control VAX. Operating levels and fade margins will be checked on a regular basis to predict (some) impending failures.

The 2 MBaud channels are driven by a VAX interface utilizing a 16-bit wide bit-slice microprocessor to buffer the unibus data path to the modem. The remote clusters use a Computrol SDLC-Multibus interface to the modem. This system operates in a polled mode and remotes may only transmit in response to a request by the host.

Frequency agile, multiple input TV modulators will be provided anywhere in the system that a camera or computer generated signal is required to be sent on the cable.

A group of CB radios have been modified to send and receive on the cable. Each set transmits on its regular CB frequency. An up-converter hetrodynes the signals to high band so they can be sent back down the cable. A down-converter is provided at each CB set so that the regular CB receiver can be used.

The Sytek System 20 units are used for terminal-to-VAX communications at 9600 baud. This is a TDMA facility so up to two hundred nodes can share a single 300 kHz channel. We will provide channel bridges so that selected channels are tied together through this

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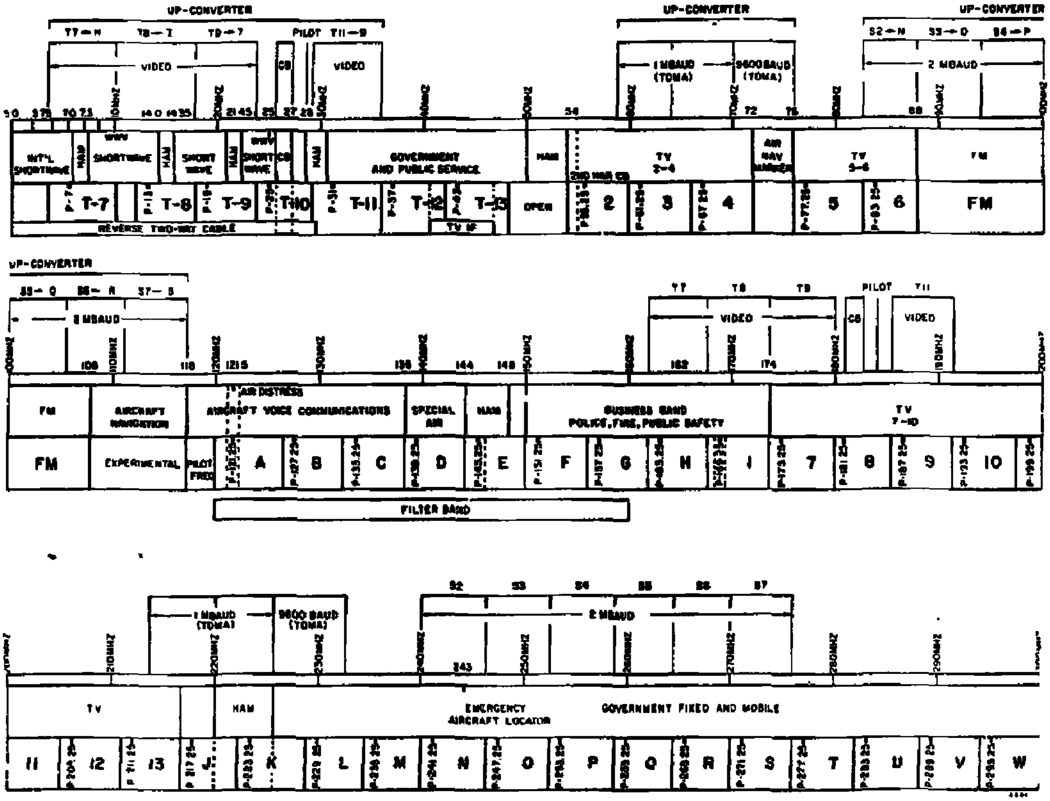

SLC BROADBAND CABLE SPECTRUM

Fig. 2. Frequency spectrum of the cable.

store-and-forward device. System 20 has a network manager facility built into the software so characteristics of any box can be changed by the network manager. Selected commands can be changed or lockout, as desired, in any box on the system.

We will provide six, 6 MHz dedicated channels for point-to-point or broadcast data. These modems are transparent to the user and will be used for pattern and fast feedback loops for beam control.

The cable systems at SLAC pass through areas of high electrical noise. The ingress of a properly installed cable system is 80 to 100 dB down. We maintain this high isolation even in the drop (equipment) cables. Double shielded cable is used in this application.

The present cable amplifiers are cable powered from two points on the site. Battery backup will be provided to these AC power supplies and to the up-converters at the injector.

We intend to do in-house installation and maintenance of the broadband system and the modems. If this cable system fails, we must have rapid response to repair it since the accelerator cannot operate without a working cable system.

References

1. W. Struven, "PEPNET - PEP Video/Data Information Network," SLAC preprint SLAC-PUB-2708 (1981).
2. W. Struven, "Mixed Video/Data Network using CATV Techniques," SLAC preprint SLAC-PUB-2711 (1981).

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