COMMUNICATION SYSTEM FOR THE TRISTAN ACCELERATORS

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ABSTRACT

Communication system used for operation of the TRISTAN accerelators consists of a ring network for control computer system, a video information network, and a broadband video/digital data network. In this paper the video information network using optical fiber cables and the broadband CATV and Local Area network are described.

INTRODUCTION

The TRISTAN accelerators -- Accumulation Ring(AR) and Main Ring(MR) -- are operated at the TRISTAN Central Control Room (TCCR) by using mini-computer network[1],[2]. Twenty-four minicomputers are connected to an optical fiber ring network[3]. Six sets of operator's console are installed in the TCCR and mini-computers are in the computer room next to the TCCR. A console for an operator consists of two Touch-Panels(TP's), two graphic display monitors and ten TV monitors[4]. Video signals are generated at Local Control Rooms(LCR's) by using TV cameras, Character Video RAM Modules(CVRAM's) or Graphic Video RAM Modules(GVRAM's) in the CAMAC crates. The CVRAM generates a signal meeting video signal standard(M/NTSC) of alpha-numeric characters with eight foreground/background colors. It can also be used for super-imposing characters on a video signal. The GVRAM module also generates an M/NTSC video signal of a graphic image in 256 colors.

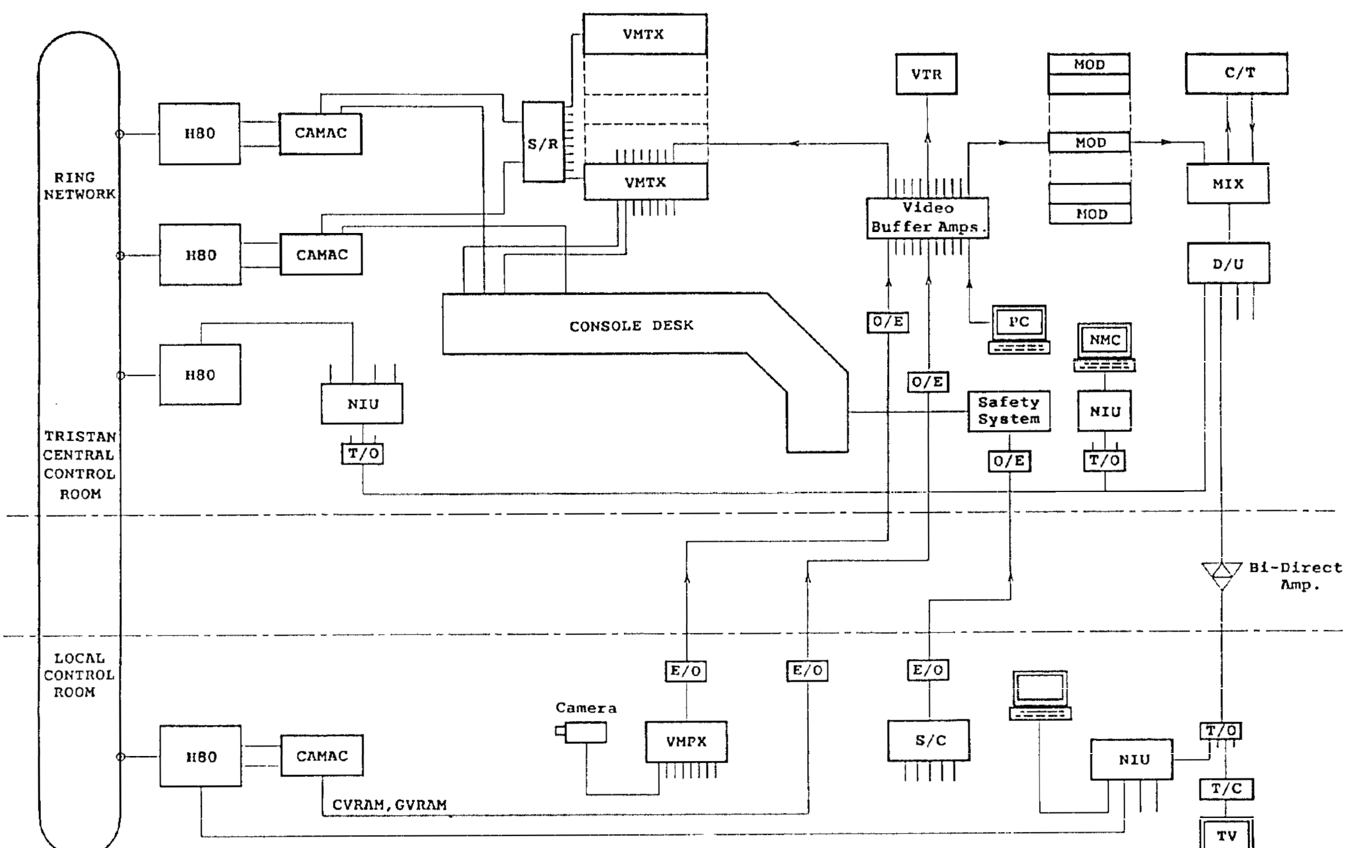
A general schematic diagram of the TRISTAN communication system is shown in Fig. 1.

Video signals generated at sub-control stations around the TRISTAN rings are sent to the TCCR via optical fiber cables. The optical fiber cables are also used for linkage of safety interlock scanning system[5].

At the TCCR, the signals are buffered and sent to the operator's consoles, a time-lapse video tape recorder, and to the CATV modulators.

From the TCCR, signals are distributed by the CATV network to the places where operators or accelerator physisits want to watch video images.

The CATV network is also used as a medium for Local Area Network(LAN) which enables terminals or personal computers used around the TRISTAN accelerators to communicate with each other.



CVRAM : Character Video RAM Module
D/U : Distribution Unit
E/O : Electric/Optical Converter
GVRAM : Graphic Video RAM Module
H80 : HIDIC 80 Minicomputer
MIX : RF Mixer
MOD : RF Modulator
NIU : Network Interface Unit
NMC : Network Management Console
O/E : Optical/Electric Converter
PC : Personal Computer
S/C : Sequence Controller
S/R : Serial data Receiver
T/C : Tuner/Converter
T/O : Tap-Off
TV : Television Monitor
VMPX : Video Signal Multiplexer
VMTX : Video Matrix Switches
VTR : Video Tape Recorder

Fig. 1. TRISTAN communication system

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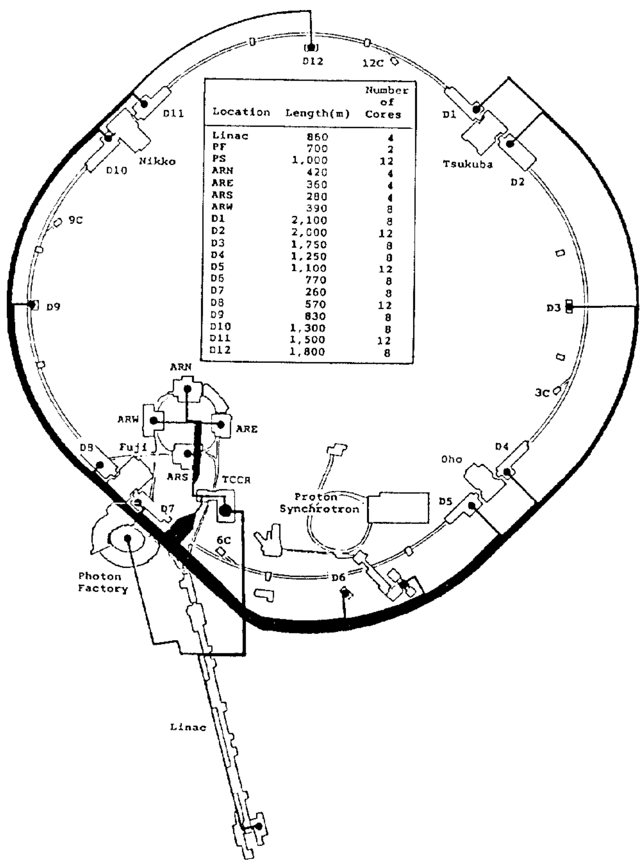
OPTICAL FIBER NETWORK

About 100 TV cameras are mounted in the TRISTAN tunnels and signals from them are multiplexed at the LCR's. There are also data which are handled on the minicomputers or microcomputers located in the LCR, and they are displayed on TV monitors by being converted into video signals. Those video signals are also sent to the TCCR through optical fiber cables. In the LCR's, electric/optical(E/O) and optical/electric signal converters are installed to convert electric signals into optical signals or vice versa. The E/O or O/E converters have an bandwidth of from 10Hz to 6MHz within 1dB gain flatness. The number of optical fiber cores and the routes btween the LCR's and the TCCR are shown in Fig. 2.

The optical fiber cables are also used for transmission of digital status signals concerning safety interlock system. Digital signals are encoded in serial form and transmitted from the LCR's by E/O converters and received at the TCCR by O/E converters.



Location	Length(m)	Number of Cores
Linac	860	4
PF	700	2
PS	1,000	12
ARN	420	4
ARE	360	4
ARS	280	4
ARW	390	8
D1	2,100	8
D2	2,000	12
D3	1,750	8
D4	1,250	8
D5	1,100	12
D6	770	8
D7	260	8
D8	570	12
D9	830	8
D10	1,300	8
D11	1,500	12
D12	1,800	8

Fig. 2. Optical fiber network

VIDEO INFORMATION HANDLING AT TCCR

There are about 100 video signals at present. Video signals collected at the TCCR are buffered by video signal distribution amplifiers and sent to video signal matrix switch(VMTX) system for operator's console and to the CATV system. Character information is added at the TCCR by super-imposing color character data over the original video signal using a CVRAM module.

Energies and intensities of electron and positron beams in the AR and the MR are plotted and displayed by two personal computers installed at the TCCR. They are connected to the control computer system by serial(RS-232C) lines.

Some important video signals are recorded by a time-lapse video tape recorder for later analysis.

As shown in Fig.3 the VMTX system consists of ten 8:8 video matrix units. Each matrix unit corresponds to one of ten TV monitors installed on the operator's console. Digital command data for the VMTX are sent from the console computers by using 32-bit serial data tranceiver CAMAC modules. Serial data signals from all console computers are received by a receiver unit and re-arranged digital control signals are outputted from the unit to the matrix units. On a console computers, a NODAL data module handles switching of video signals to be displayed on the console desk[6]. This VMTX system makes it easy for an operator to tune the accelerators, because the program automatically selects the signal which must be displayed on each TV monitor by pressing a touch-button.

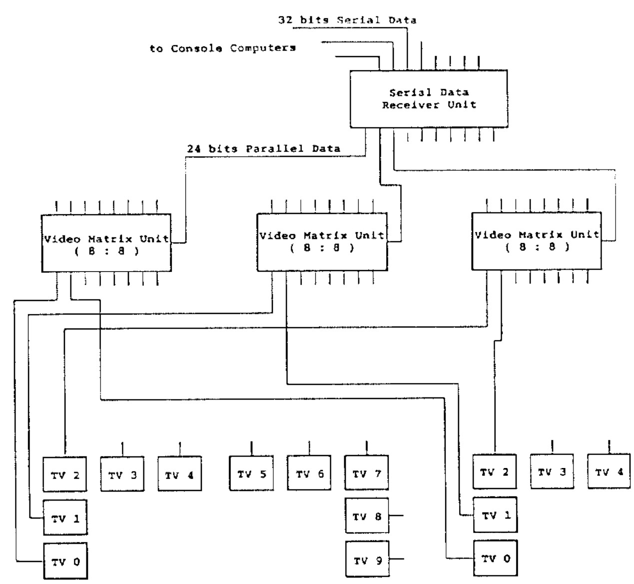


Fig. 3. Video matrix-switch system

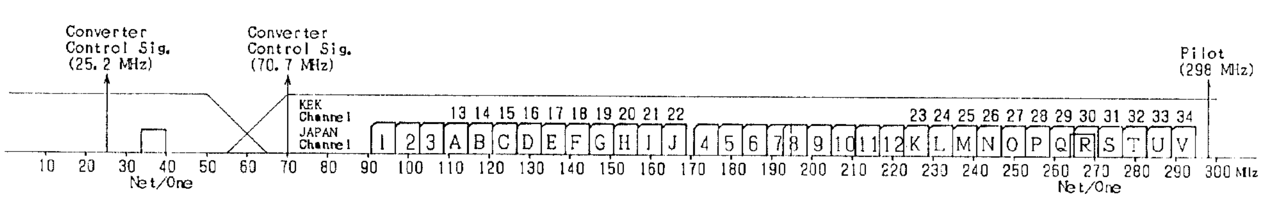


Fig. 4. Frequency allocation of the CATV network

CATV NETWORK

The CATV networks are popular in Japan as Community Antenna Television Networks for overcoming the difficulties of reception of TV signals in a small village which is surrounded by moutains or located on a far away small island. Therefore, a commercially available CATV system was installed. At our laboratory, a CATV system was already installed and is now working very well for the 12 GeV proton synchrotron[6], but is a one-direction system. A bi-directional one is chosen for the purpose of broadband digital data communication network and controlling TV tuner/converter remotely by sending digital control signals through an RF MODEM.

The CATV system is so-called sub-split one and the frequency allocation is shown in Fig.4. Forward TV channels are allocated from 70MHz through 300MHz and 32 TV channels are used for video signal transmission and one for digital data of the LAN. Reverse channels are in 10MHz through 50MHz. A pilot signal is added on 298.0Mhz to adjust the gain of trunk amplifiers. The 4800 bits/sec digital data to control TV tuner/converters is transmitted on 70.7MHz and the reply data is on 25.2MHz.

Commercially available TV receivers and the tuner/converters are used to receive RF signals. It outputs a baseband signal and an RF signal of the Japan No.2 channel. As widely commercially available TV receivers can receive channels No.1 through No.12, general information which may be interested by all personnel in the laboratory is transmitted on the channels from 1 to 12. The tuner/receiver can be controlled from TCCR to power on/off or to select TV channel.

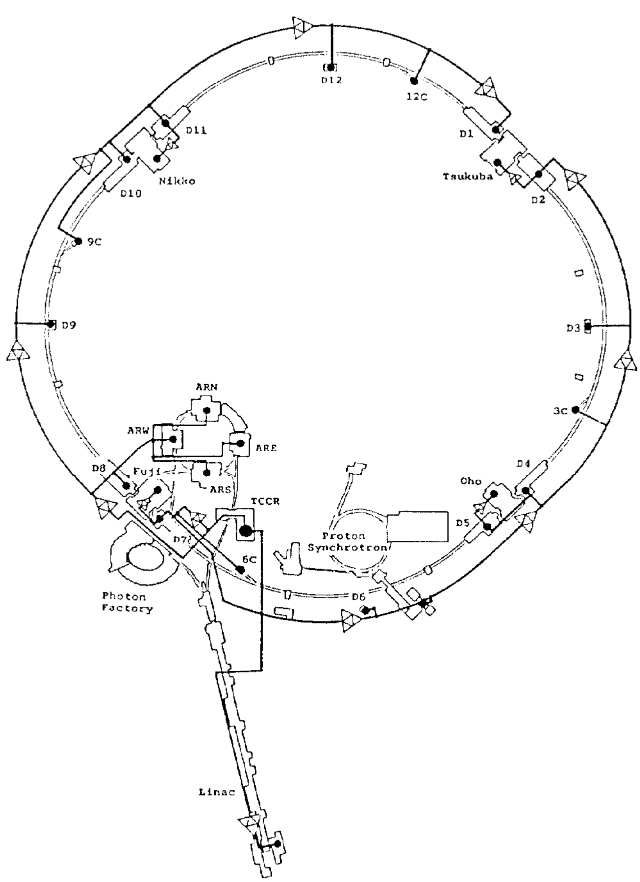


Fig. 5. Network diagram of the broadband LAN

LOCAL AREA NETWORK

The forward channel from 264.0MHz through 270.0MHz and the reverse channel from 33.9MHz through 39.9MHz are used for the LAN. The network diagram is shown in Fig. 5. The network consists of a Network Management Console(NMC), channel translators(one for backup), and 17 Network Interface Units(NIU's) with RF converters. As the original RF MODEM of the channel translater and NIU's(Net/One by Ungerman & Bass Inc.) is tuned in the frequencies suited for mid-split broadband networks, a frequency converter is required for an NIU to convert the reverse channel frequency of 33.9Mhz through 39.9MHz into 71.75Mhz through 77.75Mhz, that of the NIU.

The NIU's are installed in the LCR's and the TCCR near to minicomputers of the TRISTAN control computer system to be connected. The system console output information of the computer such as error log is not sent to the TCCR via the ring network of the computer system. Therefore, the LAN is to be used to gather and concentrate such information.

There are various equipments such as terminals, workstations, minicomputers, microcomputers, and personal computers around the TRISTAN accelerators. It is another purpose of introducing the LAN to make it possible for personnel to use a terminal as if it is connected to various computers in the laboratory.

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REFERENCES

[1] H. Ikeda, et al., "Design of the Control System of TRISTAN", IEEE Trans. Nucl. Sci. Vol. NS-28 No.3, pp. 2359-2361, June 1981.

[2] S. Kurokawa, et al.,"The TRISTAN Control System", Proceedings of 1985 Accelerator Controls Workshop, Nucl. Instr. and Meth. A247, pp. 29-36, North-Holland, Amsterdam.

[3] T. Katoh, et al., "Man-Machine Interface of TRISTAN", IEEE Trans. Nucl. Sci. Vol. NS-32 No.5, pp. 2062-2064, October 1985.

[4] S. Kurokawa, et al., "Characteristics of the TRISTAN Control Computer Network", Proceedings of 1985 Accelerator Controls Workshop, Nucl. Instr. Meth. A247, pp. 202-207, North-Holland, Amsterdam.

[5] S. Takeda, et al., "Safety and Interlock System for TRISTAN", T61 of these proceedings.

[6] E. Kadokura, et al., "A Microcomputer-Based CATV System for Accelerator Information (in Japanese)", KEK Internal 82-7, Oct. 1982.

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