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PCM SUBSCRIBER OR PAIR GAIN SYSTEM



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In suburban or rural areas experiencing rapid growth, electronic loop equipment is often used to serve new subscribers or upgrade multi-party service. These "Pair Gain" systems are economically attractive when compared to new cable installations.

However, a company with future plans to convert to digital, Class 5 switching may be reluctant to install pair-gain equipment that will not be able to offer all the features of a digital switch and its remote terminals. This sort of problem can be solved by using GTE Lenkurt's 914A system which can be operated as a 96 Line Subscriber Carrier System or terminate directly into GTE Automatic Electric's GTD-5 electronic automatic exchange.

Consider a telephone company with plans to install a GTD-5 switch in the next 2 to 10 years and an immediate need to provide service to a growing suburban area. A 914A system can be initially installed as a pair gain system and later converted to a remote terminal of the GTD-5.

Figure 1 is a block diagram of the 914A system. As shown in 1A, the system consists of a remote terminal (MXU) and a central office terminal (COT) interconnected by one or more T1 spans. Up to 96 subscriber lines can be concentrated and connected, by one or more T1 lines, to an analog central office switch. This two terminal configuration can be converted into a remote terminal GTD-5 MXU by removing the COT, as shown in Figure 1B. The removed COT can be used in other pair-gain installations.

The heart of this system is the stored program that controls all 914A system operations. It controls all call processing, controls system maintenance and diagnostic operations, collects traffic information, and performs subscriber line testing. The program that directs the remote terminal is stored at the MXU.

Program Loading

The program is automatically loaded into random access memory at the MXU via the communication link between the host and the MXU.

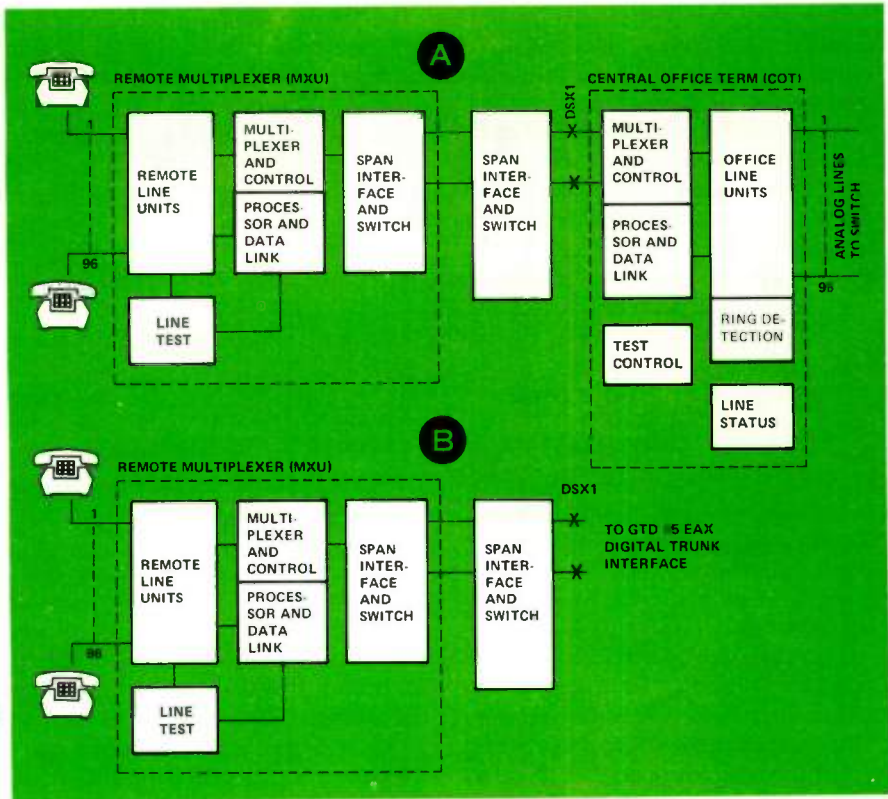


Figure 1. 914A PCM Subscriber System

The MXU may therefore be loaded with one program to operate as a subscriber carrier pair-gain system, from a permanent program in the COT, or a different program, from the base unit, when it operates as a remote terminal for the GTD-5. This arrangement also allows the software to be updated, or features to be added, by reloading the program into the MXU from either host. The MXU is reprogrammed automatically, upon restoration of service, following a power or line failure.

The system encodes analog voice signals, for PCM communications, over a T1 line in D3/D4 format.

There are 24 time slots available on one T1 line. One slot is used as a dedicated 64-kB/s data link between the MXU and either the COT or GTD-5 EAX. The 96 subscribers have full access to the remaining 23 slots, assuming a 4:1 concentration is used.

Concentration Ratios

Variable concentration ratios from 1:1 to 4:1 are provided by varying the number of T1 spans connected between the host and the MXU. Therefore, the system may be engineered to meet a considerable range of traffic requirements.

Referring to Figure 2, the recommended installation uses two T1 spans for reliability. Span switching is provided to protect the data link between the MXU and host. Traffic may be assigned to both spans, but the primary span (A), which carries the data link, has priority and is switched in the event of primary span failure. The standby span (B) should only carry overflow traffic. Therefore, it should only see traffic during very high usage periods.

The 914A system has a conservative concentration ratio of approximately 2 to 1 when used with the recommended two working T1 lines. If a single working T1 line is used, the concentration ratio increases to approximately 4 to 1 (96 lines, 23 trunks). If excessive all-trunks busy (all time slots occupied) conditions occur, it may be advisable to add one or more working T1 lines to the system to assure satisfactory service. This is easily accomplished by adding plug-in units. No special traffic administration is required for this system.

Traffic Capacity

The traffic capacity of the system with one working T1 line is estimated at 500 CCS per hour (5-1/4 CCS per line) with no intracalling and a blocking probability of 0.005 (one CCS equals 100 call seconds). With 50 percent intracalling, the capacity decreases to approximately 450 CCS per hour (4-3/4 CCS per line). With the recommended two working T1 lines, the system traffic capacity is approximately 1250 CCS per hour (13 CCS per line) with no intracalling and an estimated 1150 CCS per hour (12 CCS per line) with 50 percent intracalling and a blocking probability of 0.005.

The basic subscriber line card is equipped with four lines per card. Each line has a dedicated addressable codec that provides for time switching. Concentration of the 96 lines is provided by distributed time-space switching. Transmit and receive multiplexers provide the space switching to the codecs. All line card functions are supervised or controlled by the central processor. For exam-

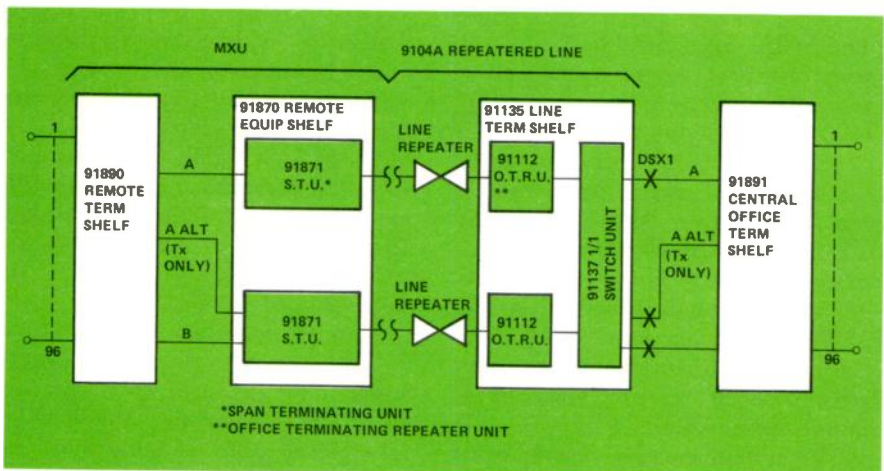


Figure 2. MXU/COT Pair Gain System (2:1 Concentration with Protection)

ple, dial pulsing on a subscriber loop is detected by microprocessor scan of the loop sense points. When the dialed digit is determined, a message containing this digit value is sent via the data link to the office. When the system is equipped with a COT, the digit is then outpulsed to the office under control of the processor in the COT.

The basic line card offers both single-party or multi-party service such as two party divided ringing with automatic number identification, 4 party bridged ringing, or 8 party divided ringing. Other line cards offer coin service or special service such as foreign exchange (FEX) trunks, and private line services. The Line Unit features are tabulated in Table 1.

Monitoring and Tests

The system is monitored by both hardware and software. Various software tests are made during call processing to verify proper functioning. The data link has a checking and confirming protocol, and retransmits if messages are not received correctly. The memory and processor are continuously tested for errors.

There are hardware alarms or status indications on such conditions as ringing generator failure, AC power failure, span switch, loss of clock, etc. All alarms are reported by LED indication at both the remote and the central office terminals. Alarm outputs are also available at the COT for connection to a remote alarm reporting system. When the 914A works into the GTD-5, the data are reported to the base-unit's administrative-display console.

A complete subscriber line test capability is provided. The COT Office Test and Traffic Unit

(O.T.T.U.) contains the test selection and operating controls for these tests, as well as a numerical display of the test results. All test selection, control and test information is carried over the data link. The following "Multimeter" tests may be performed from T-R (tip-to-ring), T-G (tip-to-ground), or R-G (ring-to-ground) of any selected loop:

- (a) AC Voltage
- (b) DC Voltage
- (c) Resistance LOW
- (d) Resistance HIGH
- (e) Capacitance

At the MXU, some tests are performed looking toward the subscriber and some toward the COT.

In addition, the following transmission tests may be performed to verify operation of each line circuit:

- (a) Ringing Voltage
- (b) Net Loss, Loop-Subscriber
- (c) Net Loss, Loop-Office

The loop-subscriber test is followed by a line seizure to confirm the supervision and signaling function of the line circuit. The net loss test may be initiated to test a single line or to test all lines with one START TEST command. Each of these last three tests responds with a PASS or FAIL display on the O.T.T.U. based on preset thresholds for these tests.

In addition, when a line fails one of these tests, a fail lamp lights on the affected line unit. When the affected unit is replaced, the replacement unit is automatically tested for all functions.

Future equipment will remote this testing function to a test desk. The GTD-5 will also perform these tests from a remote test facility.

The COT also provides traffic data that may be used to monitor the

Table 1. 914A Line Unit Features

- FOUR UNIVERSAL LINE CIRCUITS PER STANDARD LINE CARD
- TWO STANDARD AND ONE SPECIAL SERVICE LINE PER SPECIAL SERVICE LINE CARD
- ONE STANDARD LINE AND ONE COIN LINE PER COIN SERVICE CARD
- EACH LINE HAS ADDRESSABLE CODEC AND SENSE AND CONTROL CIRCUIT
- SOFTWARE ADDRESSES SENSE AND CONTROL AND ASSIGNS CODEC TO TIME SLOT
- EACH OF 96 CODECS MAY ACCESS ANY AVAILABLE TIME SLOT OF EQUIPPED REPEATERED LINES
- MXU LINE UNIT DETECTS OFF-HOOK AND DIAL PULSING AND DELIVERS RINGING
- COT LINE UNIT DETECTS RINGING AND DELIVERS OFF-HOOK AND DIAL PULSING
- TEST ACCESS TO EACH PHYSICAL LOOP VIA TEST BUS FOR:
 - INTERNAL TEST ACCESS TOWARD C.O.
 - EXTERNAL TEST ACCESS TOWARD SUBSCRIBER
 - LINE RESTORATION FOR ONE LINE
- STANDARD LINE UNITS
 - OPERATE OVER 2000 Ω LOOP (INCLUDING TELEPHONE)
 - FIXED 0.5 dB \pm 0.5 dB NET LOSS IN CARRIER (LIFETIME)
 - RING 5 HI Z STRAIGHT LINE RINGERS EACH LINE
 - PROVIDE BRIDGED OR DIVIDED RINGING (W OR W/O 2 PARTY ANI)
 - RING ANY 4 FREQUENCIES 16-2/3 TO 66-2/3 Hz (MAX 2 RINGERS PER FREQ)
- SPECIAL SERVICE UNIT
 - 2 STANDARD LINE CIRCUITS AND 1 SPECIAL SERVICE CIRCUIT
 - STRAPPABLE FOR 2-WIRE GROUND START OR
 - 2-WIRE LOOP START WITH REV. BAT. SUPERVISION
 - SEMI POST PAY COIN SERVICE
- PREPAY COIN SERVICE UNIT WITH DIAL TONE FIRST
 - PROVIDES 1 STANDARD LINE AND 1 COIN SERVICE CIRCUIT
- FUTURE LINE UNIT
 - 4-WIRE TRANSMISSION ONLY
 - 2.4, 4.8, 9.6 & 56 KBS DATA PORTS

system peak load and the all-trunks-busy (ATB) interval for a selected study period. This information is stored in holding registers of the Office Test and Traffic Unit. The holding registers record the peak hourly load since last reset and the ATB time during that peak hour. The contents of these two registers may be displayed at any time. The values displayed are peak hour system traffic in hundred call seconds

(CCS) and the cumulative time, in seconds, during that peak hour when an ATB condition existed. These registers may be reset to zero by the traffic administrator at the end of each study period.

Mechanics

The basic MXU or COT is contained in a three-level shelf which mounts in a 19-inch rack. It is 24.5 inches high and 15 inches deep. A

weatherproof, outdoor cabinet is available for mounting on either a pad or H frame. The cabinet is fabricated from high-strength aluminum which provides protection from small-caliber bullets. Battery plant, ringing generators, protectors, cross-connect hardware, and cable plant connectors are provided with the

housing. Heating and ventilating equipment is also supplied.

The 914A system plans beyond today's immediate pair-gain needs for tomorrow's digital network. The system reliably and economically provides for today's loop network needs and can merge directly into the future network.



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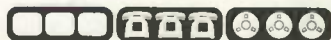
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