GROUPBAND DATA SYSTEMS (RESTORED POLAR) SWITCHED NETWORK GENERAL DESCRIPTION

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1. GENERAL

1.01 This section describes the operating principles and equipment arrangements of a model switched network providing groupband data service.

1.02 The switched network, as presently planned, is shown in simplified block form in Fig. 1. Toll offices in four major cities are interconnected by trunks using L-type multiplex equipment. Data stations are connected to their respective toll offices over wideband subscriber lines which may be repeatered wire loops, short-haul carrier facilities, or a combination of these in tandem. A wideband subscriber line may be routed through intermediate offices to the nearest network toll office.

1.03 The network consists of 4-wire, full duplex, wideband channels and 2-wire voice-frequency coordination channels. Data station interface arrangements permit the stations to be connected to a variety of customer provided business machines. The system is a general purpose system which can transmit 2-level nonsynchronous data with a minimum signal element width of 20 microseconds when operating in the nonsynchronous mode or at a fixed speed of 40.8 or 50 kilobits per second when operating in the synchronous mode.

1.04 The voice frequency coordination channels are used for talking, signaling, and supervision. They may also be used for the transmission of low-speed control data when required by the customer.

1.05 The data system described in this section provides automatically switched access from one data station to any other data station connecting to the same toll office. For these local calls, the customer dials the called station directly by prefixing the station number with a code. This code slaves the control leads of the 4-wire wideband switches to the control leads of the 2-wire voiceband switches. When a data connection is to be established over an intertoll trunk, a regular DDD telephone call is placed from the originating data station to the operator at the switchboard in the hub toll office. When the information on the desired connection has been given to the operator, the customer hangs up. The operator then places a call, over the data network, to the calling data station and then to the called data station. The operator prefixes the station numbers with a code thereby causing the control leads of the 4-wire wideband switches to be slaved to the control leads of the 2-wire voiceband switches.

2. SWITCHING ARRANGEMENTS

2.01 At most switching locations, the data signal is switched at the baseband frequencies of the data system. This switching arrangement is shown in Fig. 2. A different switching arrangement is shown in Fig. 3. In this figure, T1 Carrier Systems are used on all wideband subscriber

lines and the data circuits are switched at T1 line frequencies.

3. SIGNAL TREATMENT

3.01 The baseband data signal, transmitted from and delivered to the data sets, requires a frequency band extending from approximately 100 Hz to 50 kHz. This baseband signal, represented in Fig. 4, has been modified so that the lowest frequencies are attenuated in the transmitting data set and then restored in the receiving data set. This process, called the restored polar technique, permits satisfactory transmission of data without transmitting the dc components or the very lowest frequencies. The signal, as modified, suffers minimum impairment from the low-frequency distortions encountered in the transmission facilities; and the attenuation of low frequencies prevents interference with the carrier recovery operations of the vestigial sideband modems used in the carrier facilities.

3.02 The vestigial sideband modems used in an L-type multiplex facility translate the baseband data signal to the 60- to 104-kHz range of the group allocation of the multiplex equipment. The data signal spectra into and out of the modem is shown in Fig. 4. The modem also translates the 4-kHz voice frequency channel to and from the 104- to 108-kHz range of the group allocation.

3.03 Since it is important to avoid concentration of signal power in single-frequency components, scrambling of the data signal is provided in synchronous data sets to produce quasi-random pulse sequences, regardless of the content of the customer's data train. This function spreads the signal energy more evenly over the data channel frequency band and reduces the problem of crosstalk from single tones that may be created in the carrier facilities by repetitive data sequences (such as idle codes) from the customer's equipment. The received data signal is recovered by a de-scrambler in the data receiver.

3.04 The groupband data channel is designed to operate at zero net loss. Each wideband trunk appearance at a WSB and each data auxiliary set at a data station is a 0-dB wideband system level point (SLP). The signal transmitted from the data set has a nominal power of 0 dBm for a random data train.

4. DATA STATIONS

4.01 The 303-type data station can be used to couple any one of several types of business machines to transmission facilities. 303C-( ) and 303G-( ) data sets are available for groupband data transmission. The code letter C identifies the 50 kilobits per second speed capability and the code letter G identifies the 40.8 kilobits per second speed capability. The remainder of the code designation identifies the customer interface arrangements and mode of operation.

4.02 In addition to the data set, the wideband data station includes a data auxiliary set 806B( ) which provides access to the loop facilities and the capability for remote testing of the data station from a data test center. The data auxiliary set 804A3 is provided to permit voice communications over the voice-frequency coordination channel. A data set 103F2 is provided when it is necessary to send low-speed control data over the voice-frequency coordination channel on an alternate-use basis.

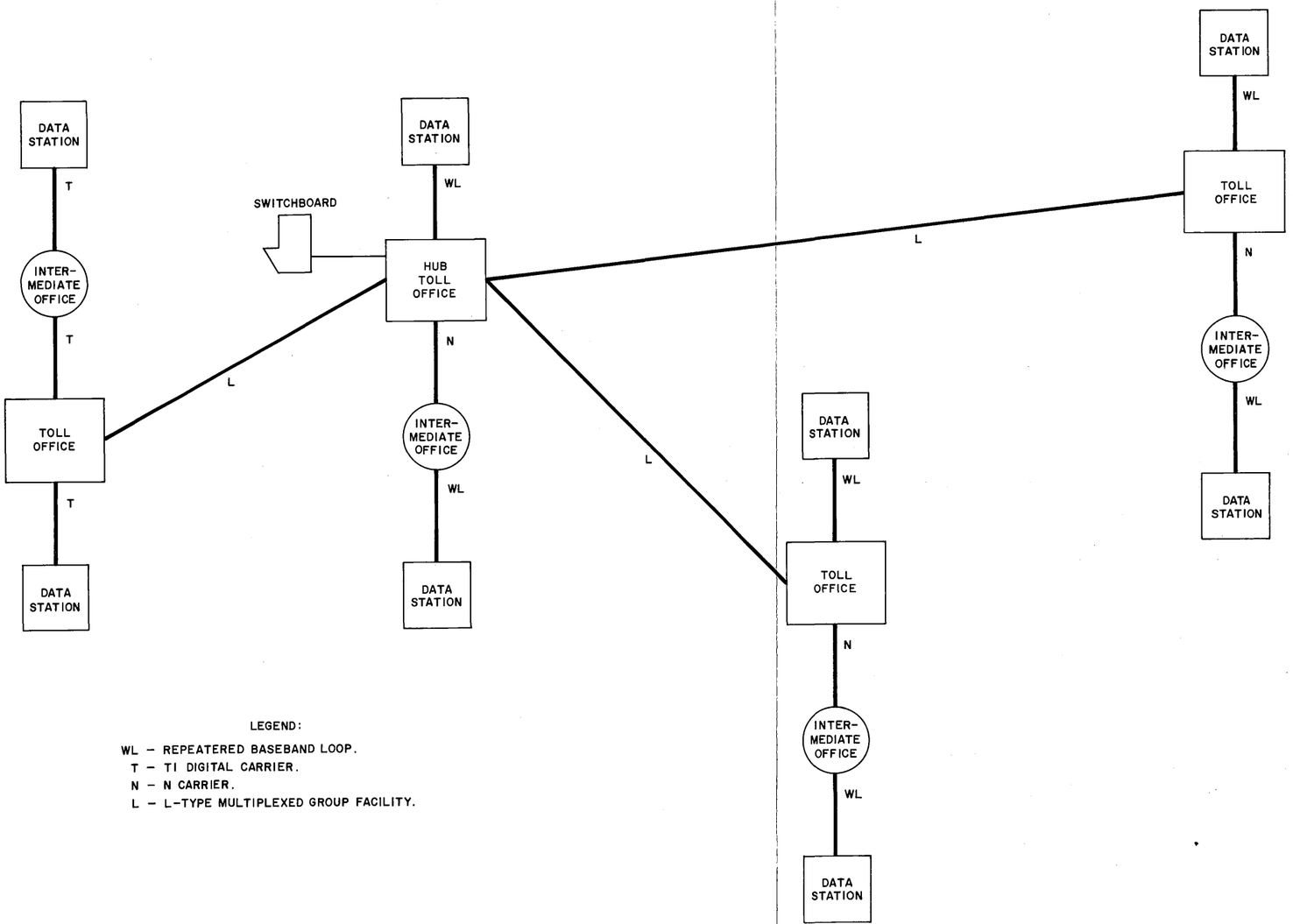
5. TRANSMISSION FACILITIES

5.01 The wideband subscriber lines connecting the data stations to the intermediate offices and/or toll offices use facilities of several kinds. Repeatered, equalized cable pairs are used where the distances are only a few miles. A digital (T1) carrier system may be used for a somewhat longer distance. At distances up to 100 miles or more an analog frequency-division (N-type) carrier facility may be used. A combination of repeatered loop and short-haul carrier in tandem may also be used. Long-haul channels use L-type multiplexed group facilities to interconnect toll offices in the network. Because signal transmission over the various kinds of facilities must necessarily be different, connections between unlike facilities are made at baseband frequencies.

A. Wideband Subscriber Lines

Repeatered Loops

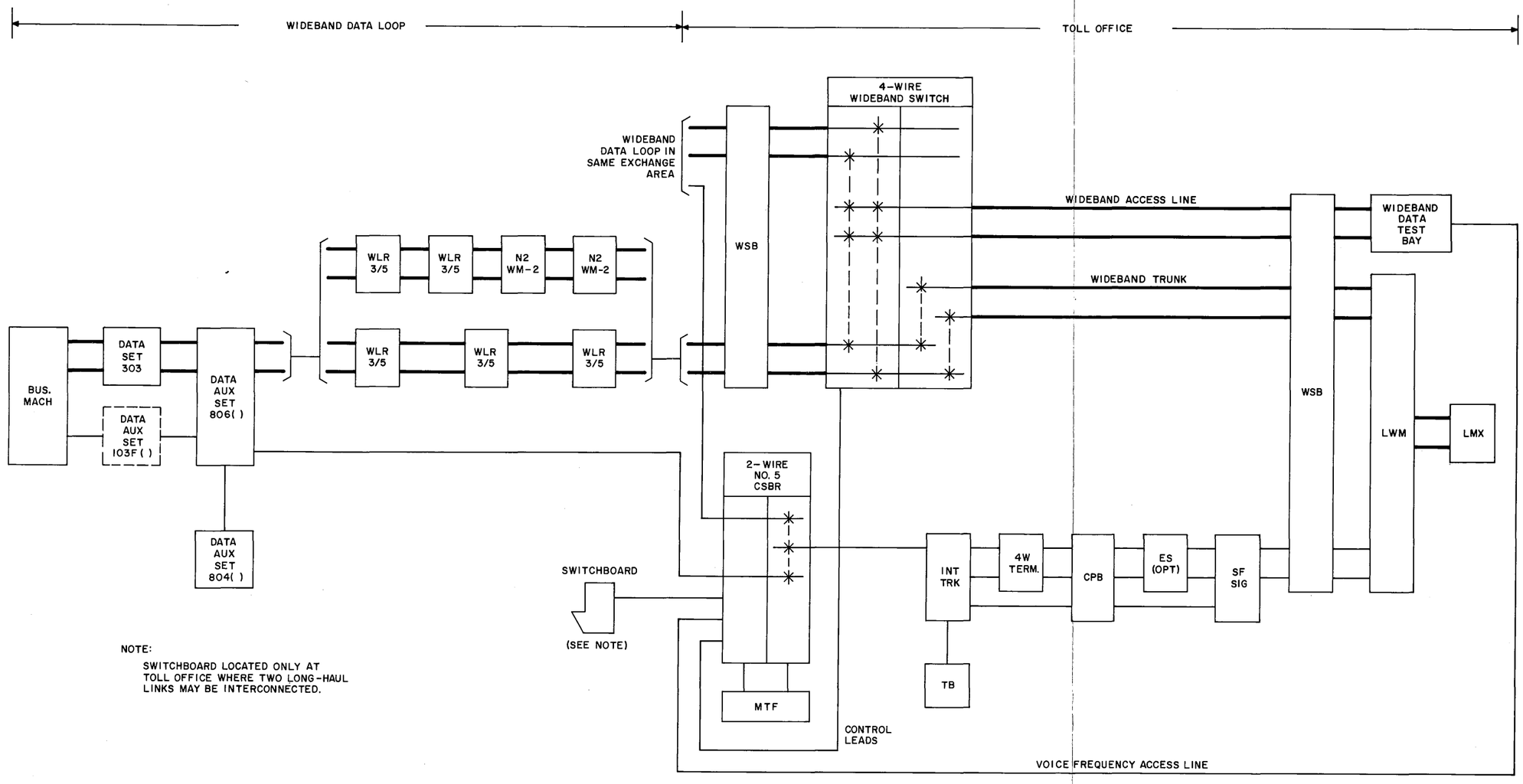
5.02 The repeaters include adjustable equalization and are located at the data stations, wideband service bays, and intermediate points. WLR-3 or WLR-5 (nonregulated) or WLR-5 (pilot-regulated) wideband loop repeaters are used.



LEGEND:

WL – REPEATERED BASEBAND LOOP.
T – TI DIGITAL CARRIER.
N – N CARRIER.
L – L-TYPE MULTIPLEXED GROUP FACILITY.

Fig. 1—Groupband Data System, Switched Network —Simplified Block Diagram



NOTE:

SWITCHBOARD LOCATED ONLY AT TOLL OFFICE WHERE TWO LONG-HAUL LINKS MAY BE INTERCONNECTED.

Fig. 2—Groupband Data System, Data Switched at Baseband Frequencies

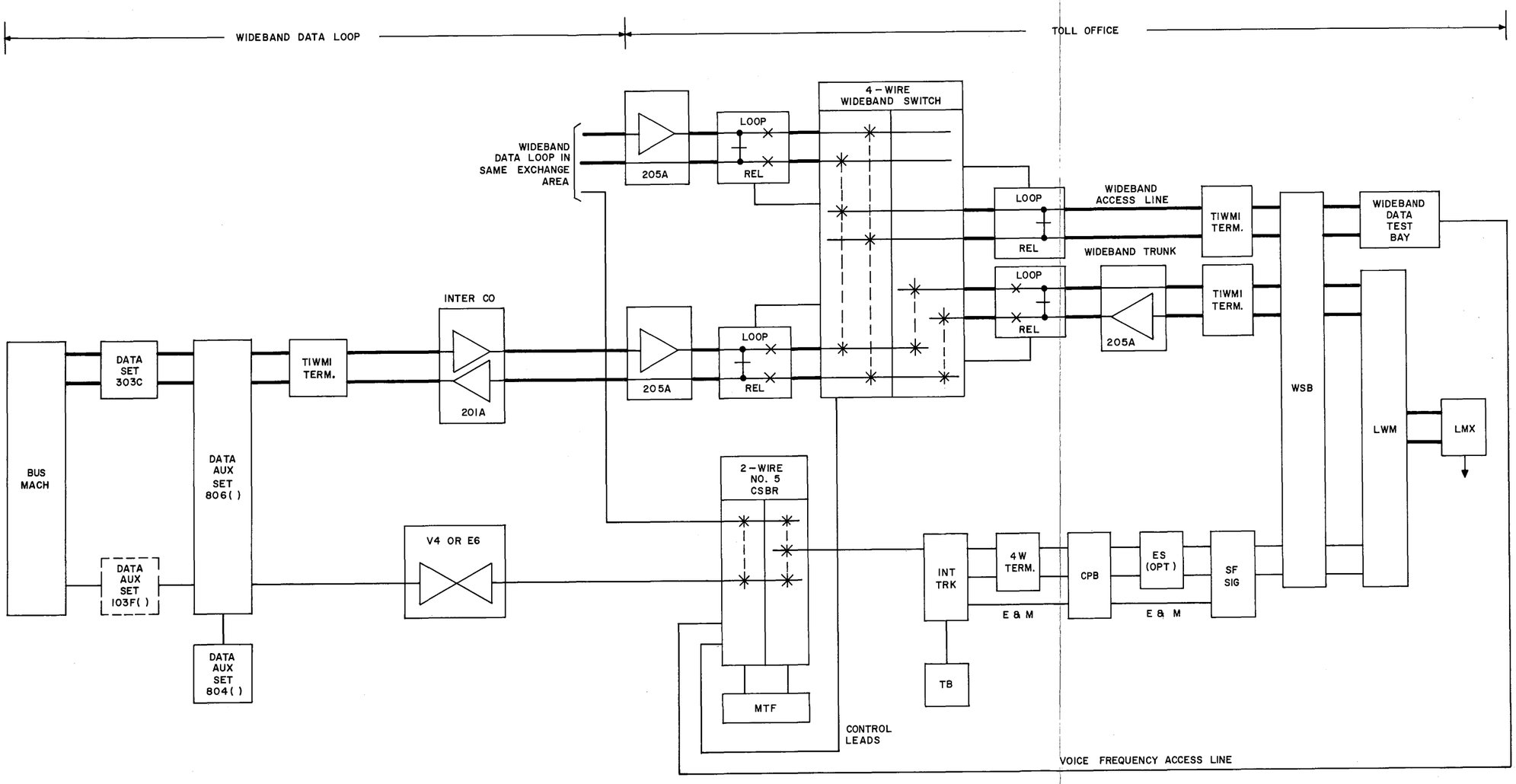


Fig. 3—Groupband Data System, Data Switched at T Carrier Line Frequencies

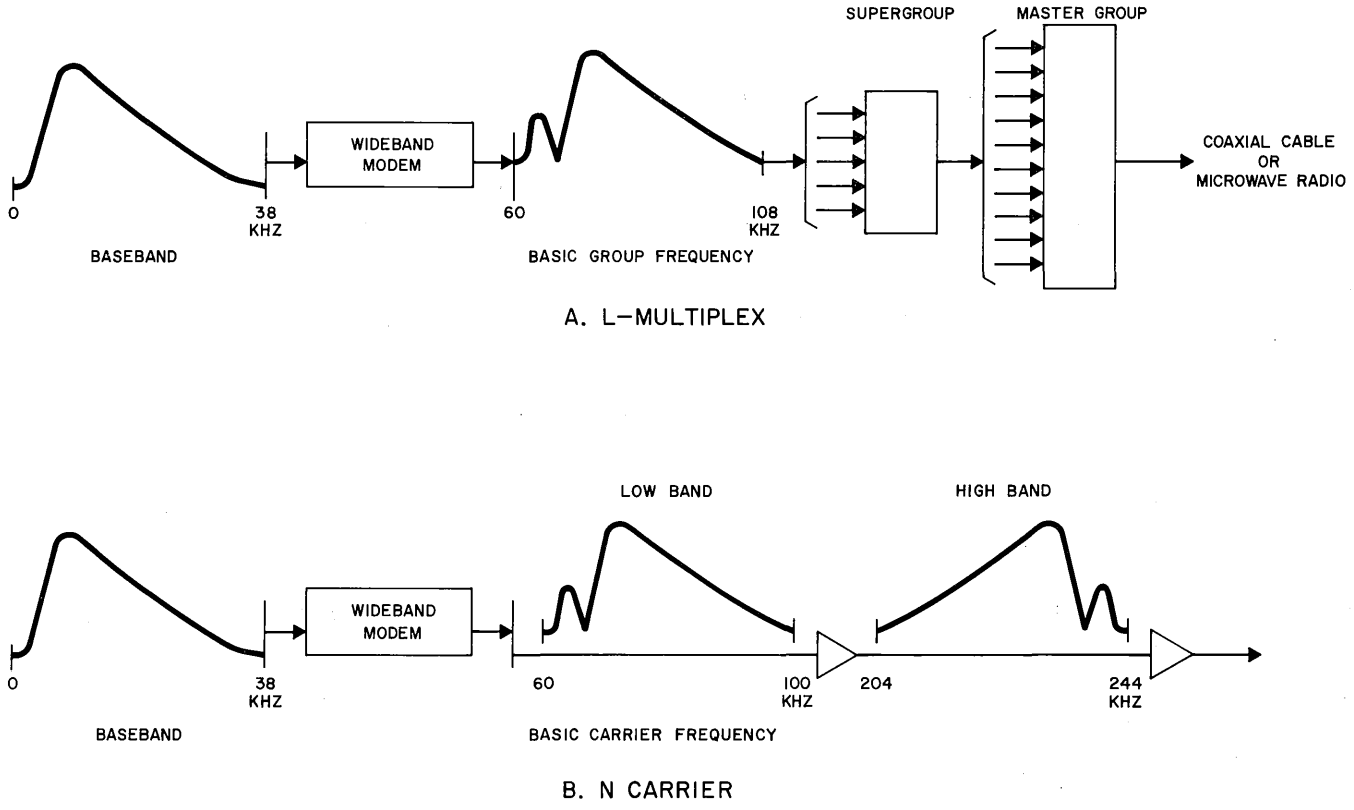


Fig. 4—Groupband Data System, Signal Structure on Carrier Facilities

T1 Digital Carrier Facilities

5.03 The T1WM-1 or T1WB-1 data terminals used in this system transmit as many as eight channels of group speed data over a T1 carrier line. This system is particularly well suited for use in data transmission; since no noise or other signal impairment is passed forward, the only imperfection in the signal is jitter in timing of signal transitions.

N-Carrier Facilities

5.04 The N-carrier system is used on links which may extend up to 200 miles but rarely exceed 100 miles. The N2WM-2 wideband modems used in group speed data transmission require the use of N2WT-1 data terminals.

B. Network Trunks

5.05 The trunks, interconnecting the major cities in the data network, use L-type multiplexed group facilities which multiplex the data signal by frequency division into the standard group format. LWM-5 or LWM-6 wideband modems are used.

5.06 The wideband modems use vestigial sideband, amplitude modulation with suppressed carrier, allowing maximum signal power. The L-type multiplex facilities are both total-power and single-tone limited. The group band extends from 60 to 108 kHz with a 104.08-kHz group pilot tone to regulate gain.

5.07 Certain group and supergroup assignments in L-type multiplex facilities are not presently recommended for wideband data service because of significant envelope delay distortion caused by group and supergroup connectors. The assignment details are given in engineering guide lines.

6. TESTING AND MAINTENANCE ARRANGEMENTS

6.01 Maintenance access is provided in the toll offices at wideband service bays (and at wideband data test bays) which are located at

serving offices. Since the jack appearances of the wideband channels in the wideband service bays are 0-dB wideband system level points (SLPs), the channel may be looped in either or both directions and tests may be made in either direction. The wideband channels always include 4-wire jack appearances in the wideband service bays on the trunk side of the 4-wire switches and, in some cases, 4-wire jack appearances are provided on the line side of the 4-wire switches. ***Jack appearances that may appear on the line side of the 4-wire switches are not considered as 0-dB wideband system level points.***

6.02 The voice-frequency coordination channels all have 4-wire jack appearances in the wideband service bays on the trunk side of the switches at -16/+7 dBm0 points.

6.03 Access is also provided from the wideband data test center through the 4-wire wideband switch so that tests of wideband customer loops and stations may be performed.

7. REFERENCES

7.01 The sections listed below give more complete details on equipment mentioned in this section.

SECTION	TITLE
314-601-120	Wideband Service Bay, Description
314-602-100	915A Wideband Data Test Bay, Description
314-641-100	WLR-3 Wideband Loop Repeater, Description
314-643-100	WLR-5 Wideband Loop Repeater, Description
356-401-100	LWM-5 Wideband Modem, Description
356-402-100	LWM-6 Wideband Modem, Description
362-812-100	N2WT1 Data Terminal and N2WM-2 Wideband Modem, Description
365-119-100	T1WM1 Wideband Modem, Description
593-012-100	Data Set 303, Description
593-800-100	303-Type Data Station Equipment, Description

7.02 The following sections are also applicable to the groupband data system.

SECTION	TITLE
314-609-310	Line-Up
314-609-311	Trouble Location
314-609-312	Routine Maintenance
314-609-510	General Maintenance
314-609-511	Gain-Frequency Adjustment
314-609-512	Noise Measurements
314-609-513	Envelope Delay Measurements