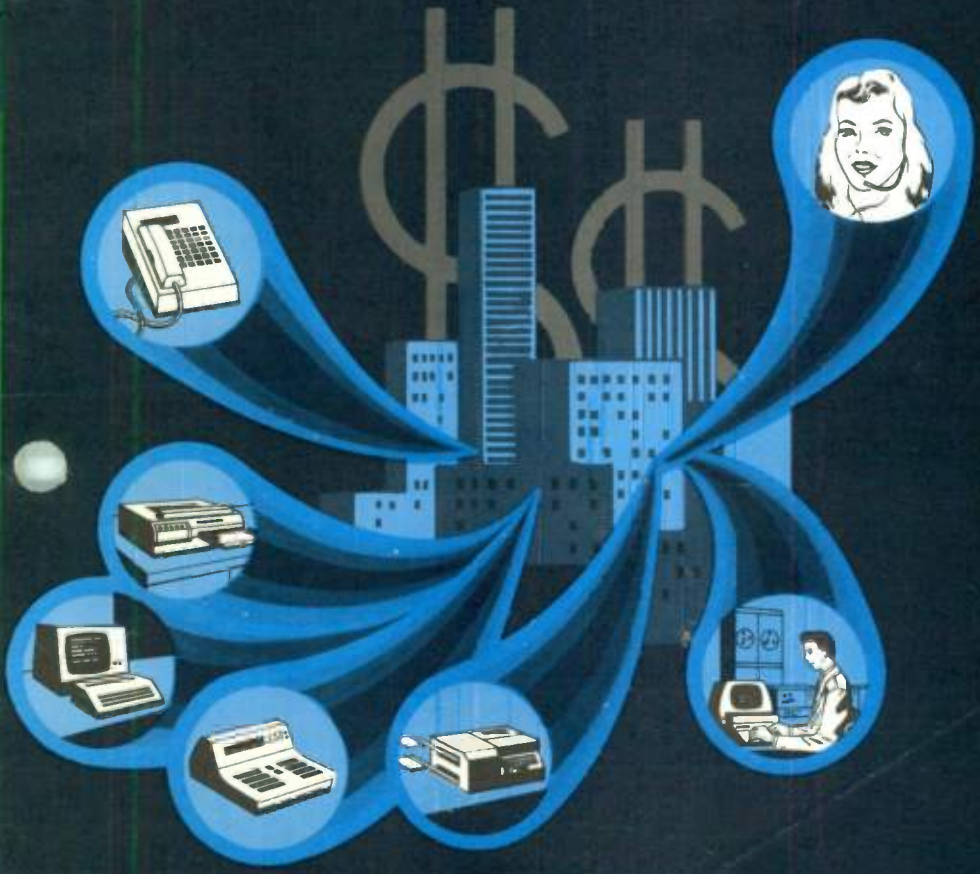
GTE Communications Transmission Systems

DEMODULATOR

JANUARY/FEBRUARY 1982



Services and Rates

Today's telephone subscriber has a choice between various competing communications services. The services fall into two general categories:

(1) Those offered by Common-Carrier, telephone operating companies including the Bell Company and independent companies.

(2) Those offered by Specialized Common-Carriers such as Microwave Communications Inc. and Southern Pacific Communications.

Both the telephone companies and the specialized Common-Carriers offer a variety of services designed to satisfy the communications requirements of business customers. By selecting the best mix of available services, a business may substantially reduce its telephone costs.

This issue of the Demodulator discusses the services and rates offered by the telephone companies. The examples used in the discussion are based on services and rates in California but the principles apply to the entire U.S. although absolute numerical results may differ. A later issue will present the same kind of discussion about the specialized Common-Carrier services and rates.

The rates used in the examples and quoted in this article are for illustrative purposes only. They are not to be used for actual rate calculations or substituted in any way for rates contained in tarrifs published by the Federal Communications Commission and the California State Public Utilities Commission.

It is well known that direct distance dialing costs less than operator assisted calls. Telephone companies offer other services which may cost even less than direct distance dialing. Among these services are:

Foreign Exchange Service
Private Line Services
Wide Area Telephone Service

The following paragraphs discuss each of these services in turn.

Foreign Exchange

Foreign Exchange (FX or FEX) Service provides a telephone number in a service area other than the one designated for the actual business location. It is like having a telephone in another town. Foreign exchange lines vary in length from less than a mile to more than 200 miles.

The rates for FX service include a monthly line charge, a mileage charge plus a surcharge which is a percentage of the basic mileage charge. Also, the local charges are usually a bit higher than those for phones located within the exchange area where the line terminates.

When the exchange where the business is located and the exchange where the line terminates are contiguous, the mileage is the airline mileage between the business premises and the closest point on the common boundary between exchanges. When the exchanges are not contiguous, the mileage is the airline mileage between the rate centers of the two exchanges.

Generally speaking, FX service can save a company money if more than 100 calls a week are being made to communities outside the business' local calling area but within the calling area of a distant exchange.

Some businesses use foreign exchange services so that their customers can place telephone orders without incurring toll charges. Other businesses limit the use of FX to outgoing calls. In this case, they simply do not publish the FX telephone number.

The following example compares direct-dialing and Foreign Exchange Costs:

Assume a firm located in downtown San Francisco California does a large part of its business with companies located 30 to 50 miles south, on the San Francisco Peninsula. Suppose that, in a typical month, the San Francisco firm placed the calls listed in Table 1. Figure 1 shows the airline paths for direct-dialed calls from S.F. to the communities in Table 1. Table 2 shows what the monthly charge would be, if the calls were dialed directly, during the business day (8:00 A.M. to 5:00 P.M., Monday through Friday).

Now suppose the company has a foreign exchange line between San

Place called	Number of calls	Total Minutes
San Carlos/Belmont	162	1,860
Redwood City	78	144
Palo Alto	240	760
Mountain View	146	348
Sunnyvale	84	602
Saratoga	20	22
San Jose	42	186
	772	3,922

Table 1. San Francisco — Peninsula Cities, One Month Calling Pattern

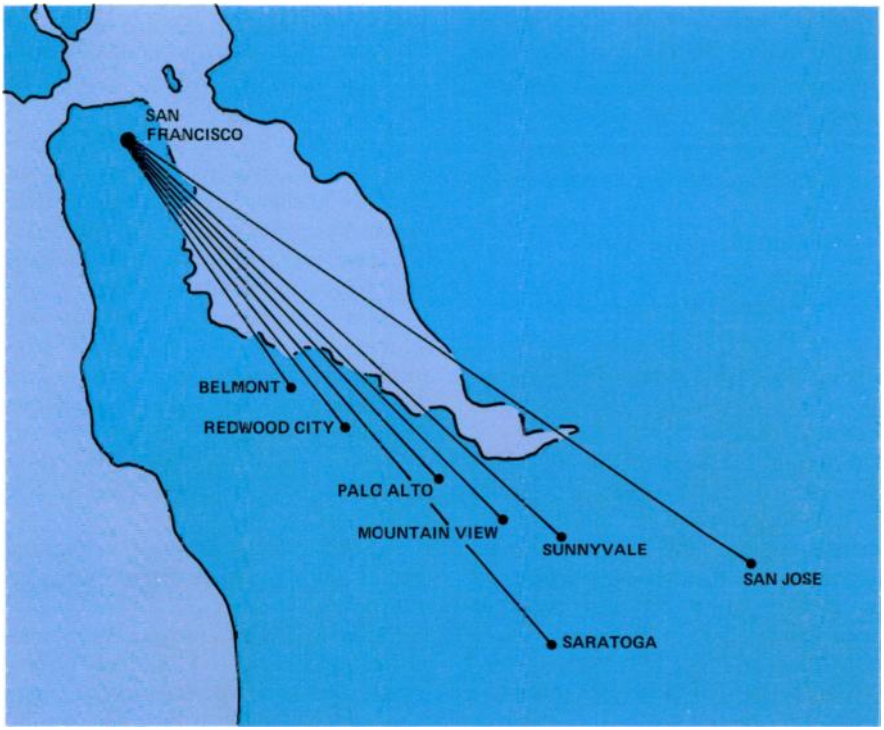


Figure 1. San Francisco — Peninsula Direct Dial Pattern

Francisco and Palo Alto. The airline miles would be as shown in Figure 2 and the charges would be as shown in Table 3.

In this example, foreign exchange service provides a savings of about 60.6% of the direct dial rate. It is interesting to note that Palo Alto is the weighted center of call distribution because so many calls went to San Carlos/Belmont exchanges. Mountain View is closer to the actual geographic center of the called communities. However, using a foreign exchange line to Mountain View would result in total charges of $411.94. Althoughd this is substantially less than the direct dialing costs, it is over $100 a month more than the charges for the same calls using the Palo Alto foreign exchange.

Table 3 shows a zone number for each community. These cities are subject to Zone Usage Measurement (ZUM) rates. In California, the ZUM system applies to the San Francisco-East Bay Extended Area and the Los Angeles Extended Area.

Under the ZUM system, calls to points within a 16 mile radius of the subscriber's exchange are sensitive to distance. Calls to communities within 8 miles are charged at one rate, calls to communities 9 to 12 miles away have a higher rate and the rate to communities 13 to 16 miles away is higher still.

Foreign exchange service in most other California communities is subject to Measured Rate Service charges. Businesses receive a monthly 300 message unit allowance for

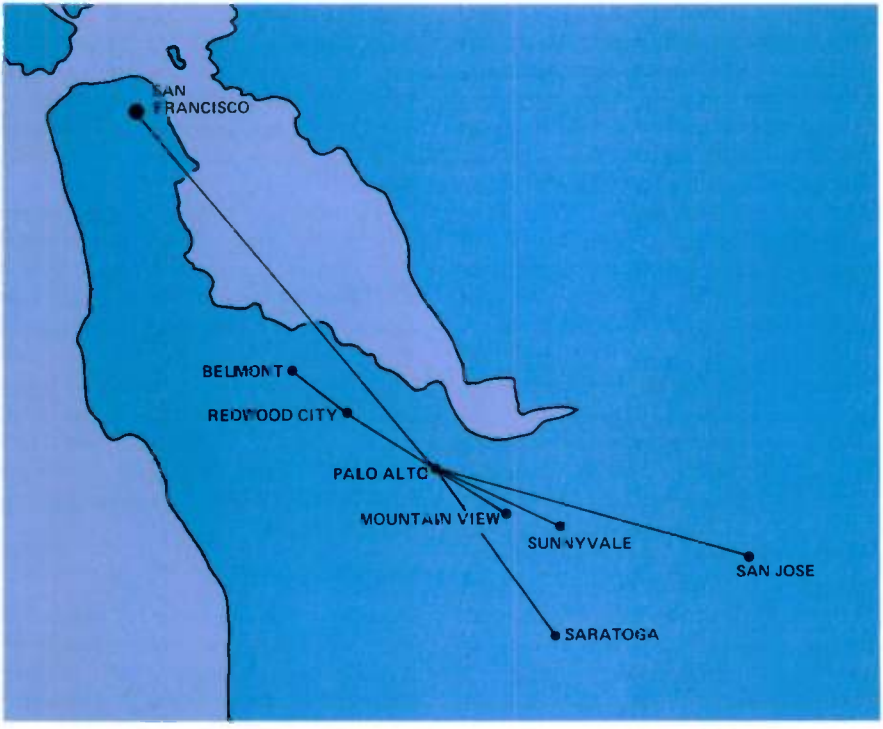


Figure 2. San Francisco — Palo Alto Foreign Exchange Line

Place called	DDD rates*	Charge
San Carlos/Belmont	.24/.15	$ 293.58
Redwood City	.24/.15	28.62
Palo Alto	.27/.18	188.40
Mountain View	.30/.21	86.22
Sunnyvale	.30/.21	133.98
Saratoga	.34/.25	7.30
San Jose (North)	.30/.21	42.84
Monthly line charge		7.00
Additional monthly charge		.15
		$ 758.09

* DDD rates are for first minute/each additional minute

Table 2. San Francisco — Peninsula Cities, Direct Distance Dialing Charges

Place called	Zone	DDD rates	Total
San Carlos/Belmont	1	.036/.012	$ 28.21
Redwood City	1	.036/.012	3.60
Palo Alto	1	.036/.012	14.88
Mountain View	1	.036/.012	7.78
Sunnyvale	2	.072/.036	24.70
Saratoga	3	.096/.060	2.04
San Jose (North)	3	.096/.060	12.67
Mileage charge (22 miles)			204.53
			$ 298.31

Note: Mileage charge includes a 5.4% surcharge on mileage plus a $15.65 monthly line charge.

Table 3. San Francisco — Peninsula Cities, Palo Alto Foreign Exchange Service Line

each PBX trunk line or a 200 message unit allowance for each individual or key telephone system line. During the business day, there is a charge of one message unit for each call of five minutes or less and an additional .2 of a unit for the sixth and each successive minute.

In communities where Measured Rate Service applies, the area which is considered "local" may be very much larger than the local areas under the newer Zone Usage Measurement Plan. As telephone rate policies evolved, the price of telephone service was based, in part, on an estimation of the probable value of that service to the average subscriber. It was apparently believed that the value of the service was related to the number of subscribers that could be reached. Thus local calling areas were defined to include a certain number of subscribers. This resulted in large "local" calling areas in sparsely populated regions.

Very Short Foreign Exchange Lines

There are cases where very short foreign exchange lines (1-4 miles) can provide significant savings. For example, the foreign exchange mileage rates between contiguous exchanges or district areas is based on the "airline distance measured from the customer's primary station or PBX attendant position to the nearest point on the common boundary of the foreign exchange or district area and the local exchange or district area."

Therefore, if a customer is located two miles away from the nearest point on the common boundary of a ZUM exchange and the nominal rate center for the adjacent exchange is thirty miles away, the customer can reach communities as far as 48 miles away for as little as $3.64 per hour plus monthly mileage and line charges. The following example shows how this kind of arrangement saves money.

Example

Suppose that a business located at the San Francisco airport made an average of two 3 minute calls per day to each of the following five communities: Berkeley, Corte Madera, Mill Valley, Richmond, and Sausalito. San Francisco airport is in the South San Francisco-San Bruno exchange. The distances and rates from South San Francisco-San Bruno to those four exchanges is shown in Table 4.

If a foreign exchange line is run from the airport to the San Francisco-

Calls	Place called	Mileage	DDD rates	Total
42	Berkeley	18	.21/.13	$ 19.74
42	Corte Madera	22	.24/.15	22.68
42	Mill Valley	21	.24/.15	22.68
42	Richmond	21	.24/.15	22.68
42	Sausalito	17	.21/.13	19.74
Monthly service charge				7.00
Additional monthly line charge				.5
				$ 114.67

Note: DDD rates are for first minute/each additional minute from South San Francisco.

Table 4. Cost of Calls from South San Francisco Exchange

Juniper exchange, the cost of that Foreign Exchange line is $15.65 per month service charge plus $12.80 per month for mileage plus a 5.4% surcharge of 69¢ for a total of $29.14.

The cost of the same group of calls from the San Francisco-Juniper Exchange is shown in Table 5.

The cost of directly dialed calls from the airport is $114.67. The cost of directly dialed calls via a foreign exchange line from the airport to the San Francisco-Juniper exchange is $71.47 (Table 5). So a very short (2 mile) foreign exchange line provides a savings of $43.50 or 37.8%.

So far, our discussion has been limited to intrastate Foreign Exchange Lines. Interstate Foreign Exchange are discussed later under Private Line Service, Type 2006.

Private Line Service

Many variations of private line service are available. Exchange private lines may connect a PBX in one building with another PBX in another building close by. Interexchange private lines may interconnect a PBX in one location with a PBX located in a different telephone exchange area in the same city.

Private line service may be a link connecting offices in two cities or it may be a series of links interconnecting any number of locations. When more than two cities are interconnected, it is important to minimize the total private line mileage. This is known as "multipoint network optimization." These techniques are beyond the scope of this article. A good discussion of the subject is in James Martin's book, "Systems Analysis for Data Transmission," Pages 687-892, published by Prentice Hall, 1972.

Private line rates are based on the airline mileage of the lines involved. State Public Utility Commissions publish methods for calculating airline mileage for intrastate private lines. In California, the method is described in CPUC Schedule 123-T. CPUC schedules 26-T and 45-T also apply to California intrastate private line service.

The Federal Communications Commission's tariff 264 prescribes the method for calculating interstate private line mileage. Mileage calculations are also discussed later in this article. FCC tariff 260 also applies to interstate private line service.

Categories of Service

There are nine basic categories of private line service available from telephone companies. These categories are:

1. Series 1000 Telemetry, teletypewriter, data remote metering, supervisory signaling, etc.
2. Series 2000 Voice

Calls	Place	Zone	DDD rates	Total
42	Berkeley	3	.096/.060	$ 9.07
42	Corte Madera	3	.096/.060	9.07
42	Mill Valley	3	.096/.060	9.07
42	Richmond	3	.096/.060	9.07
42	Sausalito	2	.072/.036	6.05
Monthly cost of FX line from airport to San Francisco-Juniper exchange				29.14
				$ 71.47

Table 5. Cost of Calls from San Francisco-Juniper Exchange via Foreign Exchange Line from San Francisco Airport

about 600 wds

3. Series 3000 Remote metering, supervisory control, signaling, and data transmission
4. Series 4000 Data transmission, telephoto
5. Series 5000 Voice, teletypewriter, wideband data transmission
6. Series 6000 Audio transmission
7. Series 7000 Television transmission, local distribution
8. Series 8000 High speed data transmission
9. Series 10000 Entrance facilities to extend customer provided communications system to a premises of the customer

Table 6 describes the services available in each category.

Table 7 shows the costs of direct dial, WATS, FX and private line services between San Francisco and Los Angeles. Comparisons are made for various amounts of usage.

These services are not functionally identical so the table should not be used as a basis for comparison. What the table does show is that a private line can be economical, if there is substantial telephone traffic between the San Francisco and Los Angeles offices of a company.

Interstate Private Line Rates

Multi-schedule private line rate schedules apply to series 2000, Type 2001 through 2006, and series 3000 voice-grade channels. There are three rate schedules (Schedules I, II and III) which apply between each pair of customer service points (rate centers) on an airline mileage basis.

Rate centers are grouped into two categories, A and B. Category A rate centers are listed in FCC Tariff 260. All other rate centers are category B and are listed in FCC Tariff 264.

Schedule I rates apply to a channel between two category A rate centers. Schedule II rates apply to a channel between a category A rate center and a category B rate center. Schedule III rates apply to channels between two category B rate centers.

The multi-schedule private line service offering is composed of two basic rate elements: interexchange channels and station terminals. A station terminal charge applies at each customer service point on an interexchange channel, as shown in Table 8.

As shown in Table 6, the designator for interstate foreign exchange service is 2006. Tables 8 through 11 show that interstate Foreign Exchange line service can save money if the monthly usage is sufficiently high. The tables also show that distance has a significant effect on rates.

Table 9 shows that an interstate foreign exchange line becomes the economical choice at some point between 25 and 50 hours of usage between Los Angeles and points within the Denver local calling area.

Table 10 shows that an interstate Foreign Exchange Line becomes the economical choice at some point between 50 and 100 hours of usage between Los Angeles and points within the Chicago local calling area.

Table 11 shows that the use of an interstate Foreign Exchange Line becomes the economic choice at some point beyond 100 hours of usage between San Francisco and points within New York's local calling area. Assuming a 3-minute average call length, local charges of $1.96 need to be added to the Foreign Exchange Line.

The three examples show that the greater the distance, the greater the number of hours of usage is required to justify the expense of a interstate Foreign Exchange Line.

5 x 2 x 60 = 600

600 wds

Table 6. Private Line Services

SERIES	TYPE	BANDWIDTH	APPLICATION
1000			Telemetry, Teletypewriter, Data, Remote metering, Supervisory signaling, etc.
	1002	0-55 BPS	Half Duplex/Full Duplex – Subvoice Grade
	1004	0-45 BPS	
	1005	0-75 BPS	Half Duplex/Full Duplex – Subvoice Grade
	1006	0-150 BPS	Half Duplex/Full Duplex – Subvoice Grade
	1007		Oversaas Channels, SF-Honolulu
	1008		
	1012		
2000			Voice Transmission
	2001	0-150 BPS 0-3400 Hz	Voice, Teletypewriter
	2002		Remote Operation of Mobile Radiotelephone
	2003		Remote Operation of Mobile Radiotelephone
	2004		Remote Operation of High Frequency System for Office of Civil Defense
	2005		
	2006		Foreign Exchange
	2007		Secure Communications, T-3 Conditioning
	2008		" " G-1 "
	2009		" " G-2 "
	2010		" " G-3 "
3000			Remote Metering, Supervisory Control, Signaling, Data Transmission
	3002	600-10,500 BPS	C1, C2, C3 and C4 conditioning available
4000			Data Transmission, Telephoto
	4001		Type 5 Data Transmission
	4002		Telephoto
5000			Voice, Teletypewriter, Wideband Data Transmission
	5701	40.8 K 50 K BPS	Data Transmission – High Speed Facsimile
	5703	19.2 K BPS	" " " " "
	5706	50 K BPS	Secure Communications
	5708		Dataphone 50
	5751	330.4 K BPS	Data Transmission
	5756	56 K BPS	Data Transmission
6000			Audio Transmission
	6001	300-2500 Hz	(Part-Time) Short-Haul Audio Transmission
	6002	200-3500 Hz	(Part-Time) Short-Haul Audio Transmission
	6003	200-3500 Hz	(Full-Time) Short-Haul Audio Transmission
	6004	100-5000 Hz	(Part-Time) Audio Transmission
	6005	100-5000 Hz	(Full-Time) Audio Transmission
	6006	50-8000 Hz	(Part-Time) Audio Transmission
	6007	50-8000 Hz	(Full-Time) Audio Transmission
	6008	50-15,000 Hz	(Part-Time) Audio Transmission
	6009	50-15,000 Hz	(Full-Time) Audio Transmission
	6010	50-15,000 Hz	(Part-Time) Dual Audio Transmission
7000			Television Transmission, Local Distribution
	7001		Full-Time or Part-Time Television Transmission
	7003		Local Distribution Systems Educational TV Full-Time, Premise-to-Premise
	7004		Full-Time, Premise-to-Premise Interexchange System
8000			High Speed Data Transmission
	8801	40.8 K 50 K BPS	Data Transmission/High-Speed Exchange
	8802		Dataphone 50
	8803	19.2 K BPS	Data Transmission
	8806	50 K BPS	Secure
	8856	56 K BPS	Data Transmission
10000			
	10001		Entrance Facilities to Extend Customer provided Communications System to a Premises the Customer

Table 7. San Francisco — Los Angeles (347 miles)

Type of service	hours of usage				
	1	10	25	50	100
Intrastate FX	$2,237.30	$2,246.30	$2,261.30	$2,286.30	$2,336.30
Type 2801 Private Line	400.99	400.99	400.99	400.99	400.99
Direct Dial	37.40	311.00	767.00	1,527.00	3,047.00
Intrastate WATS	265.00	265.00	580.00	1,000.00	1,000.00

RATE ITEMS

Station terminals	Monthly charge
Voice and Data Main Station Terminals	$25.00
Additional Station Terminal – Data	$25.00
Additional Station Terminal – Voice Separate Local Facility	$25.00
Bridged on Customer's Premises	$ 5.00
Additional Station Terminal Transfer Arrangement	$ 5.00

Installation Charge: $54.15

Table 8.

Table 9. Los Angeles — Denver (831 miles)

Type of service	hours of usage per month				
	1	5	25	50	100
Type 2006 FEX *	$ 816.10	$ 816.10	$ 816.10	$ 816.10	$ 816.10
Direct Dial	36.00	152.00	732.00	1,457.00	2,907.00
WATS (Band 2)	50.67	131.75	516.65	949.65	1,428.75

*$766.10 mileage charge. $50.00 station charge. No message units apply in Denver.

Table 10. Los Angeles — Chicago (1,745 miles)

Type of service	hours of usage per month				
	1	5	25	50	100
Type 2006 FEX *	$1,284.97	$1,284.97	$1,284.97	$1,284.97	$1,284.97
Direct Dial	37.40	159.00	767.00	1,527.00	3,047.00
WATS (Band 4)	51.98	138.30	546.10	1,002.40	1,792.10

*$1,234.97 mileage charge. $50.00 station charges. No message units apply to local calls.

Table 11. San Francisco — New York (2,571 miles)

Type of service	hours of usage per month				
	1	5	25	50	100
Type 2006 FEX *	$1,666.89	$1,674.73	$1,713.93	$1,762.93	$1,860.93
Direct Dial	38.60	165.00	797.00	1,587.00	3,167.00
WATS (Band 5)	52.40	140.40	556.10	1,021.25	1,826.25

*$1,614.93 mileage charge plus $1.96 hourly rate for 3-minute local calls. $50.00 station charges.

Wide Area Telephone Service

WATS is divided and subdivided into various categories. The first division is into Outward WATS and Inwards WATS (800) service. The subscriber has a choice as to whether a given WATS access line is arranged for inward or outward service. However, in California the same line cannot be used for both inward and outward service.

The second division of WATS is into geographic bands or service areas. Each state has an intrastate WATS which may be subdivided into bands. In some states, the same intrastate WATS access lines may be used for both incoming and outgoing WATS.

National or Interstate WATS is divided into six bands. The bands are incremental, so the first three bands are automatically included in a subscription to band 4. A subscriber to band 6 will have WATS to all fifty states except his home state. He will also have service to the District of Columbia, Puerto Rico and the U.S. Virgin Islands.

Figure 3 shows the WATS interstate bands for California North and Figure 4 shows the interstate bands for California South. Note that there are some differences between the first three bands for California North and California South. However, taken collectively, the three bands include the same states for both areas and bands four through six are identical.

Rates for interstate WATS bands are established by American Telephone and Telegraph Inc. sub-

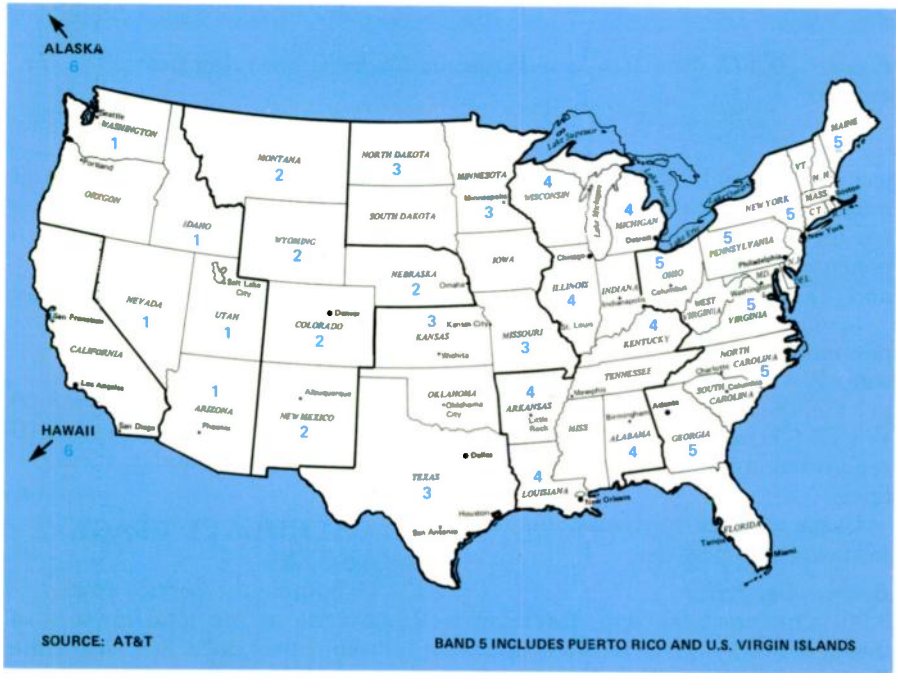


Figure 3. WATS Band Map for Subscribers in California North Area Codes 209, 408, 415, 707, and 916

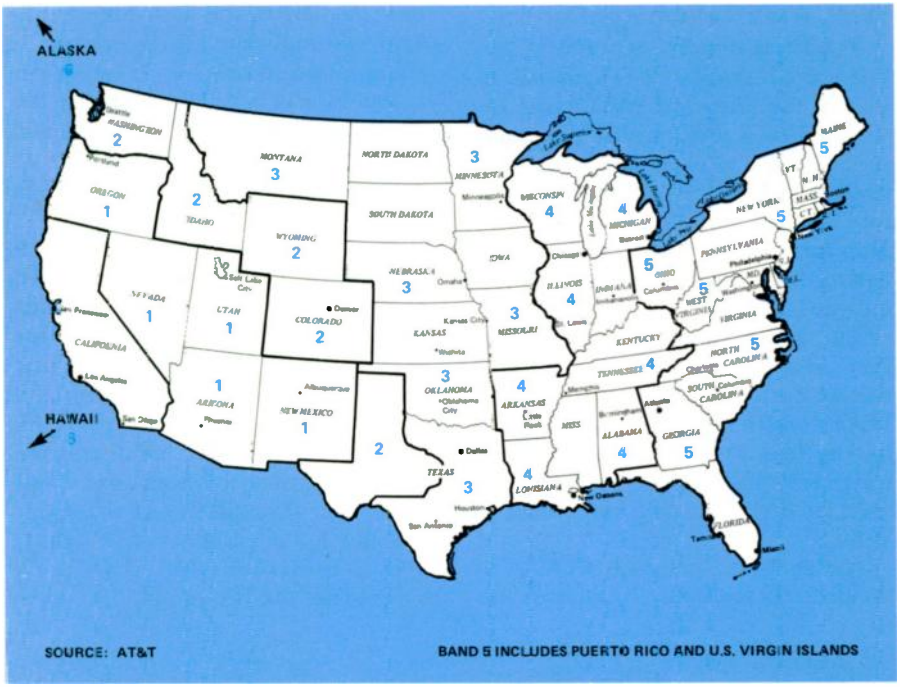


Figure 4. WATS Band Map for Subscribers in California South Area Codes 213, 714, and 805

ject to approval by the Federal Communications Commission. Charges for the service consist of two components: (1) a monthly access line fee and (2) usage charges.

In California, the access line fee per month is $30.40 for each Outward WATS line. The access line fee per month is $35.35 for each Inward WATS 800 service line; 800 service requires a minimum of two access lines.

Usage charges are based on the following rate periods:

Business Day Period

8:00 a.m. to 5:00 p.m. Monday through Friday. The business Day Period for holidays (New Year's, Independence Day, Thanksgiving Day, Labor Day, Christmas Day, or resulting legal holidays) is charged at Evening Period Rates.

Evening Period

5:00 p.m. to 11:00 p.m. Sunday through Friday.

Night/Weekend Period

11:00 p.m. to 8:00 a.m. all days, 8:00 a.m. to 11:00 p.m. Saturday; 8:00 a.m. to 5:00 p.m. Sunday.

TO CALCULATE USAGE CHARGES

1. Determine the Service Area.
2. Determine the total number of completed calls for each rate period for each service group.
3. Apply the Minimum Average Time Requirement of one

minute by dividing the number of completed calls for each rate period in each service group by 60.

4. Determine the total actual hours used for each rate period for each service group.
5. Determine the total chargeable hours for each rate period for each service group. This is the greater of (3) or (4) above, rounded to the nearest tenth (one decimal place).
6. Determine the number of access lines, within each service group, in service during the month. Access lines in service for a fraction of a month are based on the number of days in service divided by 30 days. The result is rounded to the nearest hundredth (two decimal places). The same number of access lines is used for each rate period.
7. Determine the average usage for each rate period for each access line in each service group by dividing the chargeable hours for each rate period in (5) above by the number of access lines in (6) above.
8. Determine the usage charge per rate period for each access line by applying the corresponding rates.
9. Determine the total usage charge for each rate period for each service group by multiplying the usage charge per rate period in (8) above by the number of access lines in (6) above.
10. Determine the total usage charge for all rate periods in each service group by adding the results of (9) above.

Fractional parts of an hour are billed in tenths of an hour.

Where the monthly total of completed calls exceeds the number of minutes used, charges will be computed by using a one minute average for completed calls. The access line fee is assessed during the current month of use. Charges for usage are billed the following month.

The rates which apply to interstate WATS for telephone subscribers in California are shown in Tables 12,

Table 12. Interstate WATS Rates for Outward Service California North, Time of Day Rate Schedule, Usage Rates/Access Line Rate

Service Area	USOC	First 15 Hours		Next 25 Hours		Next 40 Hours		Over 80 Hours		
		Day	Even.	Day	Even.	Day	Even.	Day	Even.	Night
1	WT1	19.49	12.67	17.33	11.27	15.20	9.89	12.86	8.36	6.77
2	WT2	20.48	13.30	18.22	11.85	15.97	10.38	13.51	8.78	7.11
3	WT3	21.09	13.71	18.79	12.21	16.46	10.71	13.92	9.05	7.33
4	WT4	21.58	14.02	19.20	12.49	16.83	10.94	14.24	9.26	7.49
5	WT5	22.00	14.30	19.57	12.72	17.16	11.15	14.51	9.43	7.65
6	WT6	28.53	18.54	25.39	16.51	22.25	14.46	18.83	12.24	9.99

Notes:

1) Time of day rate periods: Day – 8:00 a.m. to 5:00 p.m., Monday through Friday
Evening – 5:00 p.m. to 11:00 p.m., Sunday through Friday
Night – 11:00 p.m. to 8:00 a.m., all days, also 8:00 a.m. to 5:00 p.m. Sundays

2) Usage rates are applied to each access line. Charges are based on usage measured to the nearest tenth of an hour, or the number of completed calls if the average call length is less than one minute.

3) A monthly charge of $30.40 applies for each Outward WATS access line. An additional monthly charge of $15.60 applies for Four Wire Terminating Arrangement.

4) One time installation charges of $167.75 per Outward WATS line also apply.

Source: Pacific Telephone

through 15 inclusive. The states which are included in the various WATS bands are shown in Figure 3 and Figure 4.

Interstate outward and inward WATS service is generally less expensive than directly dialed calls if there is an average of more than four hours of interstate calls placed per month.

The rates and charges for intrastate WATS are set by the California State Public Utilities Commission and published in Schedule 128-T.

Cost Comparisons: Ten-Hour Intrastate Outward WATS

Subscribers may not find ten hour Intrastate WATS to be the least expensive service, even though their monthly telephone bill shows ten hours or more of long distance calls to points within California. Statewide, ten hour WATS costs $265 per month ($26.50 per hour). Direct dialed, non-WATS calls, to points more than 245 miles away, cost 62¢ for the first minute and 45¢ for each minute thereafter.

In addition to distance, the average call length has a strong influence on which type of service is less expensive. If the average intrastate call is four minutes long, the average cost per call is $1.97 ($29.55 per hour). It is apparent that 10-hour statewide WATS is $3.05 per hour cheaper than direct dialing.

The average call length for voice transmission is said to be approximately four minutes while the average call length for data transmission is seven minutes. Intrastate seven minute directly dialed calls to points more than 245 miles away cost $3.32 ($28.46 per hour), $1.96 per hour more expensive than statewide WATS. Direct dialing costs more than ten-hour statewide WATS for data traffic.

Cost Comparisons: Ten-Hour Intrastate Inward WATS (800) Service

Subscribers may find inward WATS less expensive than accepting collect calls, if the monthly bill includes more than 6 to 8 hours of col-

Table 13. Interstate WATS Rates for 800 Service California North, Time of Day Rate Schedule, Usage Rates/Access Line Rate

Service Area	USOC	First 15 Hours Day	First 15 Hours Even.	Next 25 Hours Day	Next 25 Hours Even.	Next 40 Hours Day	Next 40 Hours Even.	Over 80 Hours Day	Over 80 Hours Even.	Night
1	8L1	18.35	13.22	16.76	12.07	15.18	10.93	13.44	9.68	8.75
2	8L2	18.92	13.62	18.39	12.44	15.65	11.27	13.86	9.98	9.02
3	8L3	19.27	13.88	17.61	12.69	15.93	11.47	14.11	10.15	9.18
4	8L4	19.55	14.08	17.86	12.86	16.16	11.64	14.31	10.30	9.32
5	8L5	19.78	14.24	18.07	13.01	16.35	11.78	14.49	10.43	9.43
6	8L6	25.68	18.49	23.37	16.83	21.32	15.35	18.75	13.50	12.33

Notes:

1) Time of day rate periods: Day – 8:00 a.m. to 5:00 p.m., Monday through Friday
Evening – 5:00 p.m. to 11:00 p.m., Sunday through Friday
Night – 11:00 p.m. to 8:00 a.m., all days, also 8:00 a.m. to 5:00 p.m. Sundays

2) Usage rates are applied to each access line. Charges are based on usage measured to the nearest tenth hour, or the number of completed calls if the average call length is less than one minute.

3) A monthly charge of $35.35 applies for each 800 Service Access Line. An additional monthly charge of $15.60 applies for Four Wire Terminating Arrangement. 800 Service requires a minimum of two Access Lines, per service group.

4) One-time installation charges of $352.55 per pair of Incoming WATS lines also apply.

Source: Pacific Telephone

Table 14. Interstate WATS Rates for Outward Service California South, Time of Day Rate Schedule, Usage Rates/Access Line Rate

Service Area	USOC	First 15 Hours Day	First 15 Hours Even.	Next 25 Hours Day	Next 25 Hours Even.	Next 40 Hours Day	Next 40 Hours Even.	Over 80 Hours Day	Over 80 Hours Even.	Night
1	WT1	19.14	12.44	17.04	11.07	14.94	9.71	12.63	8.21	6.65
2	WT2	20.27	13.42	18.04	11.72	15.82	10.29	13.38	8.70	7.04
3	WT3	21.09	13.71	18.79	12.21	16.46	10.71	13.92	9.05	7.33
4	WT4	21.58	14.02	19.20	12.49	16.83	10.94	14.24	9.26	7.49
5	WT5	22.00	14.30	19.57	12.72	17.16	11.15	14.51	9.43	7.65
6	WT6	28.53	18.54	25.39	16.51	22.25	14.46	18.83	12.24	9.99

Notes:

1) Time of day rate periods: Day – 8:00 a.m. to 5:00 p.m., Monday through Friday
Evening – 5:00 p.m. to 11:00 p.m., Sunday through Friday
Night – 11:00 p.m. to 8:00 a.m., all days, also 8:00 a.m. to 5:00 p.m. Sundays

2) Usage rates are applied to each access line. Charges are based on usage measured to the nearest tenth hour, or the number of completed calls if the average call length is less than one minute.

3) A monthly charge of $30.40 applies for each Outward WATS access line. An additional monthly charge of $15.60 applies for Four Wire Terminating Arrangement.

4) One-time installation charges of $167.75 per Outward WATS line also apply.

Source: Pacific Telephone

Table 15. Interstate WATS Rates for 800 Service California South, Time of Day Rate Schedule, Usage Rates/Access Line Rate

Service Area	USOC	First 15 Hours Day	First 15 Hours Even.	Next 25 Hours Day	Next 25 Hours Even.	Next 40 Hours Day	Next 40 Hours Even.	Over 80 Hours Day	Over 80 Hours Even.	Night
1	8L1	18.14	13.06	16.58	11.93	15.01	10.81	13.29	9.96	8.64
2	8L2	18.81	13.54	17.18	12.38	15.56	11.20	13.77	9.91	8.95
3	8L3	19.27	13.88	17.61	12.69	15.93	11.47	14.11	10.15	9.18
4	8L4	19.55	14.08	17.86	12.86	16.16	11.64	14.31	10.30	9.32
5	8L5	19.78	14.24	18.07	13.01	16.35	11.78	14.49	10.43	9.43
6	8L6	25.68	18.49	23.37	16.83	21.32	15.35	18.75	13.50	12.33

Notes:

1) Time of day rate periods: Day – 8:00 a.m. to 5:00 p.m., Monday through Friday
Evening – 5:00 p.m. to 11:00 p.m., Sunday through Friday
Night – 11:00 p.m. to 8:00 a.m., all days, also 8:00 a.m. to 5:00 p.m. Sundays

2) Usage rates are applied to each access line. Charges are based on usage measured to the nearest tenth hour, or the number of completed calls if the average call length is less than one minute.

3) A monthly charge of $35.35 applies for each 800 Service Access Line. An additional monthly charge of $15.60 applies for Four Wire Terminating Arrangement. 800 Service requires a minimum of two access lines, per service group.

4) One-time installation charges of $352.55 per pair of Incoming WATS lines also apply.

Source: Pacific Telephone

lect calls from points within California. Collect calls, averaging three minutes each, can cost as much as $37.00 per hour.

The monthly cost of ten hour, statewide, incoming WATS is $340. The Northern or Southern California rate is $265 per month.

Based on a straight comparison of hourly costs, it appears that inward WATS is less expensive than accepting collect calls. However, this is not always true. The average time duration of the calls in minutes and the average distance from which the calls are placed greatly affect the cost as shown in the following examples:

Example 1

The telephone bill for a business in Southern California included 120 operator-assisted incoming calls (collect, credit-card, and calls billed to a

third number) totaling 480 minutes (8 hours) and costing $309.60. The telephone bill revealed that the calls came from area codes in both Northern and Southern California.
The appropriate WATS service for such group of calls would be statewide incoming WATS. The cost of ten hours of statewide incoming WATS is $340. For this particular example, WATS would not be cheaper. If all of the calls had been placed from area codes 213, 714, and 805, Southern California incomings WATS could be used, at a cost of $265. In this case the use of incoming WATS would result in a saving of $44.60.
In the example above, the average call length was 4 minutes.

Example 2
The telephone bill for a business in Southern California included 180 incoming collect calls totaling 360 minutes (6 hours) costing $361.80. Inspection of the telephone bill revealed that the calls came from points in both Northern and Southern California. Since the cost of 10-hour statewide incoming WATS is $340 per month, $21.80 could have been saved by the use of WATS.

The hourly cost of ten-hour California intrastate inward WATS services (California North/South, or California statewide) drops rapidly as usage increases from one hour per month to ten hours and drops slowly thereafter.

The per hour cost of 100-hour California intrastate inward WATS service drops rapidly for the first forty hours of usage.

The hourly cost of 10-hour intrastate inward WATS (California statewide) is less than the hourly cost of 100-hour inward WATS up to 41 hours. At 41 hours and above, 100-hour intrastate inward WATS is a less expensive alternative.

Intrastate Outward WATS

Ten-hour California North or South Intrastate Outward WATS cost $210 per month ($21.00 per hour). Even if all calls are within the subscriber's own service area, this may or may not be less expensive than direct dialing. If the calls are to points less than 130 miles away, direct dialing will usually be cheaper than local area WATS.

In summary, direct distance dialing is usually less expensive than ten-hour intrastate WATS if the calls are to points less than 130 miles away or to points outside the subscriber's service area (California North or South). Furthermore, direct dialing from any point to any other point in California will cost a maximum of $1.38 for a four-minute call, if the call is made between 5:00 p.m. and 11:00 p.m., Monday through Friday. This equals $20.69 per hour, which is less than the $21.00 per hour, single service area, ten-hour WATS rate.

The hourly cost of ten-hour WATS for California North or California South drops rapidly as the usage increases from one to ten hours and drops slowly thereafter. Up to eight hours of calls made to points at least 245 miles away will be less expensive if dialed directly. If eight hours of calls or more (to points at least 245 miles away) are made, California (North or South only) intrastate WATS will be less expensive than direct dialing.

The hourly cost of ten hour California Statewide WATS drops rapidly as the usage increases from one hour to ten hours and drops slowly thereafter. Although direct dial may be less expensive (depending on

call length) than ten-hour California statewide intrastate WATS if there are eight hours of calls or less to points at least 245 miles away, the service will save you money above ten hours up to about 46 hours. At about that point, the two California 100-hour intrastate WATS services become the more economical choice.

Direct Distance Dialing

In California, direct distance dialing may be less expensive than intrastate WATS particularly when evening or night rates apply. Evening and night rates provide for discounts of 30% and 60% respectively off the business day rates.

Check carefully to see whether direct distance dialing is cheaper in your local calling area than 10 hour or 100 hour WATS. It usually is, unless the call is one minute or less.

Direct distance dialing is less expensive than 10 hour intrastate WATS during night-time hours (11:00 p.m. to, but not including, 8:00 a.m. Monday through Friday and all day Saturday and Sunday) regardless of the length of the call.

Direct distance dialing is also less expensive than 10 hour intrastate WATS during evening hours (5:00 p.m. to but not including 11:00 p.m.) if the calls last two minutes or more and is always less expensive than 10 hour intrastate WATS for calls made to points up to 90 miles away. There are other cases where direct dialing is less expensive than intrastate WATS. Compare the cost of services carefully to see which service is cheapest for your situation.

Direct distance dialing costs for nationwide interstate calls now need to be compared much more carefully with interstate WATS rates which were restructured in mid-1981. The new interstate WATS rates include a discount for evening and night calls.

Analyze Your Telephone Equipment

Having the most suitable equipment can reduce telephone costs. A modern private branch exchange (PBX) can have special features such as Automatic Route Selection (ARS) also known as Least Cost Routing LCR), Station Message Detail Recording (SMDR), Class of Service restriction (COS), Automatic Trunk Queuing, etc. A business with a PBX that does not have these features might consider upgrading its PBX.

The Automatic Route Selection feature causes the PBX to select the least-expensive, available route. If the least expensive route is busy, the person attempting to place the call may be required to wait or may have the call placed over the next more expensive route. Some PBX's with Outward Trunk Queuing can delay the placement of the call over a more expensive route. The delay may be set at a fixed maximum time or it may be applied only to certain telephones, if the PBX is equipped with COS (Class of Service) to distinguish between various levels of priority. For example, a call placed from a phone assigned to a senior executive might be assigned a Class of Service which would assure that there would be no waiting to get an outside line—the least expensive route if available, or direct-dial if no less expensive route is available. On the other hand calls placed from a telephone assigned to a lower ranked executive might be delayed until the least expensive route is available and telephones generally available to all personnel might be restricted from making calls to points outside the

area code or local calling area.

Station Message Detail Recording (SMDR), sometimes referred to as CDR (Call Detail Recording), is important because it provides a record of outgoing calls placed over WATS lines. WATS bills show only the number of hours of usage, not the numbers to which the calls were placed.

If you have a key system instead of a PBX, buttons may be labeled "OUT OF STATE," "800,"CAL LONG DISTANCE," "PALO ALTO AREA," etc. A detailed memo explaining the system should be sent to everyone using the telephones so that long distance calls would not be placed over the foreign exchange line (costing more than normal direct dial) or local calls would not be placed over the intrastate WATS, etc.

Telephone Rates

In the past, telephone rates were based in part on the perceived usefulness of a service. In the early days of telephony, it was felt that the greater number of subscribers that could be called, the more valuable the service was. The rates reflected how many subscribers were in a rate area rather than the cost of providing the service. Revenues from profitable services subsidized unprofitable services.

Over several decades of operation, agreements have been developed between the telephone companies, the Federal Communications Commission, and the individual state public utility commissions. These agreements generally amount to a series of "cost-plus" contracts. Rate increases have generally been allowed, if the telephone operating company proves two things. First, that its expenses have increased, and second, that the rate increase will not increase the company's profit above a certain defined "allowable" maximum percentage.

In recent years, the telephone companies have moved towards relating rates to costs. The current method for determining telephone rates is extremely complex, and is likely to remain so for the foreseeable future. The bibliography lists references for readers who would like to pursue the subject.

Calculating Distances

Distance-sensitive rate calculations generally involve the calculation of the number of airline miles between the rate center of the calling party and the rate center of the party being called. The following paragraphs describe how those distances are presently calculated and how these methods evolved.

In 1918, towards the end of World War I, the United States Post Office took over the operation of the Bell System facilities. During that brief period, U.S. Post Office personnel introduced the use of Post Office maps for making rate mileage calculations. One of the consequences of this was the distance from one community to another was considered to be the distance between their main post offices.

The system went unchanged for many years and then, over a three-year period beginning in 1959, the Bell System introduced a different system of calculating rate mileage. Bell personnel laid a series of closely spaced vertical and horizontal lines over a map where the earth's surface has been represented as if it were flat. The basic technique for producing such map was developed in the late

18th century by Johann Heinrich Lambert, a native of Alsace.

A copy of a simplified version of Bell's map of the United States showing the major vertical and horizontal grid lines is shown in Figure 5. The advantage of such a map is that it simplifies the calculation of airline mileages.

The spacing between adjacent vertical grid lines and between horizontal grid lines represents a distance of one coordinate unit. A four-digit vertical (V) and a four-digit horizontal (H) coordinate is computed for each rate center. A pair of V-H coordinates locates a rate center, for determining airline mileages, as a particular intersection of an established vertical grid line with an established horizontal grid line. The distance between any two rate centers is the airline mileage computed between their respective coordinate intersections.

The method for computing the distance is similar to that used for determining the length of the hypotenuse of a triangle. It is easier than the methods required for calculating airline mileages based on longitude and latitude.

This concludes our discussion of the special services offered by telephone companies. Services offered by Specialized Common Carriers will be discussed in a future issue.

BIBLIOGRAPHY

1. *Communications Cost Control Handbook, California Edition.* Telephone Rate and Data Service, Inc., San Francisco, CA. 1981.

2. F. Griesinger, *How to Cut Costs and Improve Service of Your Telephone, Telex, TWX and Other Telecommunications,* McGraw-Hill Book Company, New York, N.Y. 1974.

3. *Intercity Services Handbook,* AT&T Long Lines Marketing Department, Bedminster, N.J. Generally available throughout the Bell System.

4. J. Martin, *Systems Analysis for Data Transmission,* Prentice Hall Inc., Engelwood Cliffs, N.J. 1971.

5. J. McNamara, *Technical Aspects of Data Communication,* Digital Equipment Corp., Bedford, Mass. 1978.

6. *Exchange Service Telephone Rates* and *Long Distance Message Toll Telephone Rates* are annual reports published by the National Association of Regulatory Utility Commissions — P.O. Box 684, Washington, D.C. 20044.

The Federal Communications Commission, Tariffs and Services Division, and the State Public Utility Commissions are excellent sources of information.

We would like to express our sincere appreciation for the expert help we received in preparing this issue of the Demodulator. Almost the entire text was extracted from Communications Cost Control Handbook, Copyright 1981, San Francisco Research Group. The book is published by their affiliate, Telephone Rate and Data Service, Inc., 669 Clay Street (Suite 300) San Francisco, California 94111. Tel. (415) 921-4800.

GTE LENKURT
1105 COUNTY ROAD
SAN CARLOS, CALIFORNIA 94070

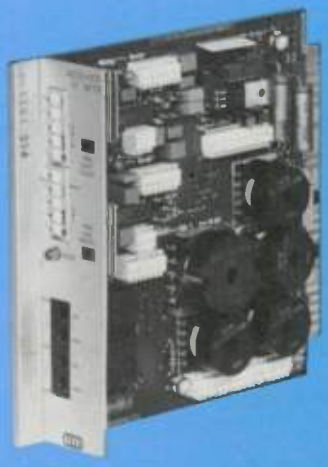
ADDRESS CORRECTION REQUESTED

Bulk Rate
U. S. Postage
PAID
San Carlos, CA
Permit No. 37

ES 94025PATT0120GO

MR. W R PATTON
120 GABARDA
MENLO PARK CA 94025

GTE Lenkurt's 4600 2-Wire Voice Frequency Repeater



Standard Features:

- Front panel test jacks
- Simultaneous East/West gain and equalization adjustment
- Automatic low frequency equalization
- Built-in toll filters
- Built-in idle disable
- Disable during dialing
- Built-in comp nets
- Low power consumption (10 ma.)

Available Features:

- Plug-on precision balance networks (Universal, H88, D66 and non-loaded)
- Plug-on loop treatment subassemblies

The 4600 VFR is a four coil hybrid repeater with front panel, prescription gain and equalization. The 4600 operates with positive net loss (gain) in most applications.

The 4600 is ideal for mixed gauge applications. Its design eliminates the need for charts, for equalization adjustment, because adjustment is linear.

For additional information please call or write:
Special Service Products Division
GTE Lenkurt Incorporated
876 Ventura Street, Aurora, Colorado
Phone: (303) 363-7300 Ext. 253

GTE LENKURT

VIDEO, VOICE & DATA
TRANSMISSION SYSTEMS

The GTE Lenkurt Demodulator is circulated bimonthly to selected technicians, engineers and managers employed by companies or government agencies who use and operate communications systems, and to educational institutions. Permission to reprint granted on request.

LITHO IN U.S.A.

GTE Communications Transmission Systems

DEMODULATOR

NOVEMBER/DECEMBER 1981

PCM SUBSCRIBER OR PAIR GAIN SYSTEM

Microwave Engineering Book Now Available. See Back Cover.

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.

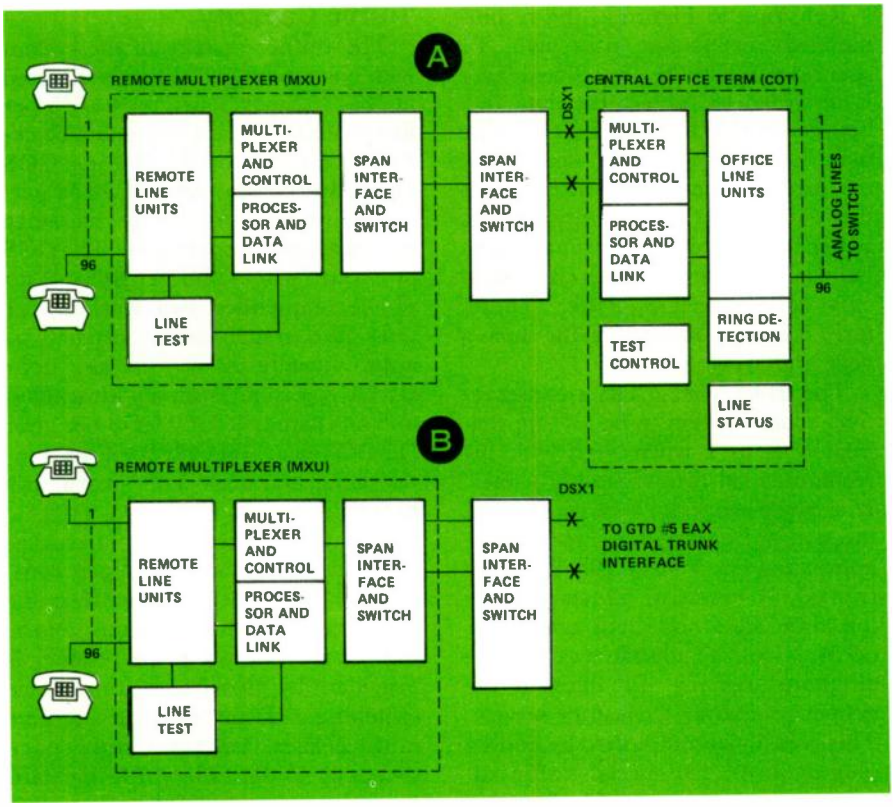


Figure 1. 914A PCM Subscriber System

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-

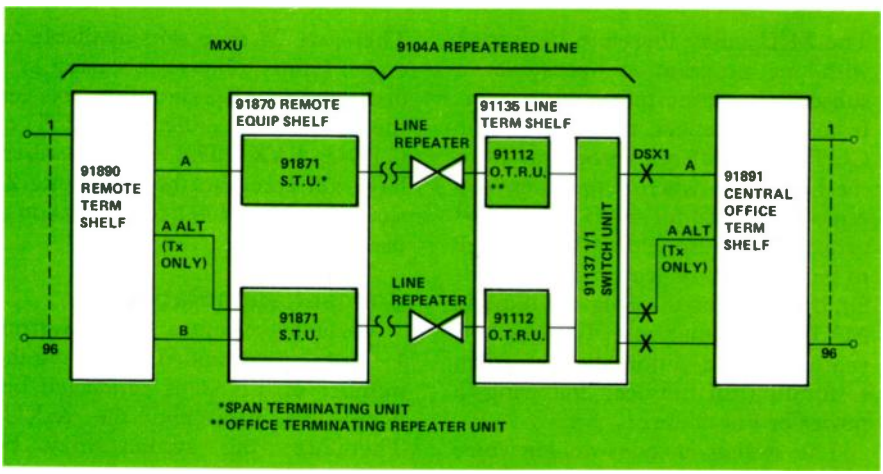


Figure 2. MXU/COT Pair Gain System (2:1 Concentration with Protection)

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 2000Ω LOOP (INCLUDING TELEPHONE)
  - FIXED 0.5 dB ± 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.

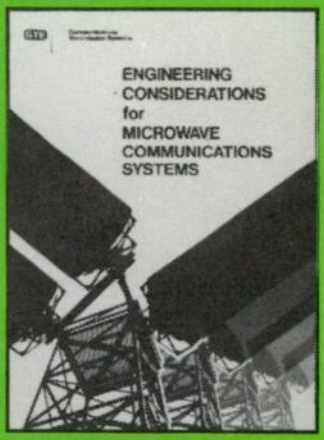
GTE LENKURT
1105 COUNTY ROAD
SAN CARLOS, CALIFORNIA 94070

ADDRESS CORRECTION REQUESTED

Bulk Rate
U. S. Postage
PAID
San Carlos, CA
Permit No. 37

ES 956730BRIPO-BFO
ADM MGR
PACIFIC TEL CO
MR. J J O BRIEN
PO BOX 700
RIO LINDA CA 95673

Responding to numerous requests, we have reprinted **Engineering Considerations for Microwave Communications Systems.** This fourth printing has a soft cover. It is priced at $10 per copy mailed to U.S. addresses and $20 per copy mailed to foreign addresses. Prepayment is requested with your order. Orders may be placed by writing to:



Mrs. Claudine Lucier
GTE Lenkurt, Inc. MS C-134
1105 County Road
San Carlos, California 94070

GTE LENKURT

VIDEO, VOICE & DATA
TRANSMISSION SYSTEMS

The GTE Lenkurt Demodulator is circulated bimonthly to selected technicians, engineers and managers employed by companies or government agencies who use and operate communications systems, and to educational institutions. Permission to reprint granted on request.

LITHO IN U.S.A.