COMMON CONTROL SWITCHING ARRANGEMENT FOR SWITCHED SERVICE NETWORKS GENERAL DESCRIPTIVE INFORMATION

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1. INTRODUCTION

GENERAL

1.01 Common control switching arrangement (CCSA) provides for the interconnection of customer locations by means of private network facilities using voice channels that are switched at 2- or 4-wire No. 5 crossbar (and on a limited basis at 2-wire No. 1 ESS centrex) switching centers. These networks are intended primarily for large industrial customers and government agencies who require extensive voice, telegraph, and data communications. Each customer location has dedicated access lines to the local CCSA switching center and dedicated network trunks between CCSA switching centers. A network switching center can be shared by a number of independent networks In addition, a 2-wire switching center can be utilized as a centrex-CO and can provide regular telephone service to POTS customers. The network configuration used by a CCSA network is a 3-level hierarchical plan similar to the plan used by the DDD network.

FEATURES

1.02 The features of the CCSA offering are noted in the following paragraphs. These features are CCSA features only and do not necessarily represent all the PBX or centrex service provided at a customer location through his normal PBX or centrex service offering.

A. Uniform Numbering Plan

1.03 A CCSA network uses a standard 7-digit numbering plan (NNX-XXXX). Each station on the network, whether a PBX station, a centrex station, or a station directly terminated at a network switching center, is assigned a different 7-digit address. When a station is associated with a manual PBX, a switchboard, or key equipment requiring the attendant to complete calls in and out of the network, the 7-digit address is assigned to the attendant access lines instead of to the stations.

B. Network-In-Dialing (NID)

1.04 Network-In-Dialing (NID) provided by the CCSA offering is analogous to direct inward dialing (DID) provided by the centrex package offering. A dial PBX (PBX or centrex) or a directly terminated network station can be called using the network by dialing the 7-digit address of the called station. Any manual PBX, or key system station can be called on the network by dialing the 7-digit address of the PBX or key system attendant. The attendant will then connect the call through to the station.

C. Network-Out-Dialing (NOD)

1.05 Network-Out-Dialing (NOD), provided by the CCSA offering, is analogous to direct outward dialing (DOD) provided by the centrex package offering. Any nonrestricted dial PBX, centrex or directly terminated network station user can directly dial a network call. Any manual PBX or key system station user can place a network call through an associated attendant.

D. Transfer of NID Calls

1.06 Call Transfer—Individual or Call Transfer—Attendant on NID calls to centrex, dial PBX, or manual PBX locations is provided with CCSA service. The type transfer provided depends upon the type transfer provided with the centrex or PBX service subscribed to by the customer.

1.07 Table A shows the type transfer provided with the various PBX and centrex service offerings.

TABLE A

CCSA TRANSFER FEATURES

TYPE SERVICE	TYPE TRANSFER
Manual PBX	Call Transfer — Attendant
Series 100	Call Transfer — Attendant
Series 200	Call Transfer — Attendant
Series 300	Call Transfer — Individual
Centrex I	Call Transfer — Attendant
Centrex II	Call Transfer — Individual

E. Automatic Alternate Routing

1.08 Automatic alternate routing is provided by the CCSA offering when the customer network configuration permits the feature.

1.09 The originating switching center will route all calls over the direct route trunks as long as any of these trunks are idle. When the direct route trunks are busy, additional calls are routed to first alternate route trunks connecting to another switching center and at that point switched through to the destination switching center. If both the direct route and first alternate route trunks are busy, the originating switching center attempts to route all additional calls to a second alternate route trunk group.

F. Automatic Message Accounting (AMA) Traffic Sampling of Network Usage

1.10 The CCSA offering provides for the recording of a maximum of 20 percent (100 percent at No. 1 ESS office) of network attempts on a continuous sampling basis. This sample data is recorded by AMA equipment and is available to the operating company to aid in the engineering and administration of the customer network.

G. Optional Universal Service (Off-Network Calling)

1.11 As an optional feature of the CCSA offering, a network customer may elect to have access to an exchange area for local or direct distance dialing (DDD) calling. This universal service provides, at the customer option, both calls from the CCSA network to an exchange area and calls from an exchange area to the CCSA network.

1.12 Off-network calls leaving the CCSA network and requiring toll facilities for completion to the called end will undergo a toll charge only for the toll portion of the call.

1.13 Off-network calls entering the CCSA network for completion to a station on the network will be screened by an attendant. If the call is accepted, the attendant will complete the call to the network station.

2. SWITCHING PRINCIPLES—NO. 5 CROSSBAR OFFICE

A. CCSA Numbering Plan

2.01 The numbering plan for a CCSA network provides each CCSA station with a 7-digit all numerical network address, NNX-XXXX, where 1X can be any digit 2-9 and X can be any digit 0-9. The NNX portion of the address identifies the customer location where the station is homed. The NNX digits are arbitrarily assigned but must not be the same as the NNX digits assigned to a customer location for regular message network use. The remaining XXXX digits are the numbers of the individual station at the customer location and are generally the same for both CCSA and regular message network use. These seven digits provide

the CCSA customer with a uniform dialing plan for network calls.

2.02 Following are some of the basic types of customer locations available in a CCSA network with an applicable numbering plan for each.

(a) ***Directly Terminated Station, Key Equipment or Manual PBX:*** This type of customer location is homed directly on a CCSA switching center. The NNX digits in the address are the codes assigned to the CCSA switching center. The last four digits (XXXX) of the address are the station numbers assigned to access line terminations in that switching center.

(b) ***Dial PBX:*** This type of customer location is generally arranged for network-in-dialing (NID), and in most cases each location will be assigned an individual NNX code. In some cases, however, the NNX code will be shared by two or more of the customer dial PBXs homed on the same switching center. Under this condition the thousands digit in the NNX-XXXX address must be different for each of the dial PBX locations. The last four digits of the address (two or three digits for some PBXs) will be the existing PBX station numbers. Although a shared NNX code is possible for a customer dial PBX location, the NNX code must not be shared by two different CCSA customers, homing on the same switching centers.

(c) ***Centrex-CU and Centrex-CO:*** This type of customer location is always arranged for NID. The assignment of NNX code and 4-digit station numbers has the same requirements as described for dial PBX customer locations.

(d) ***Centrex-CU and Centrex-CO Satellites:*** A centrex satellite has the same NNX code as the associated main centrex. The thousands digit in the NNX-XXXX address of the station must not be the same for both the main and satellite facilities.

2.03 Following are three requirements for assignment of CCSA NNX codes.

(1) The NNX code assigned to a particular customer must never be duplicated at ***another switching center*** within the same CCSA network. The NNX code can be shared by a maximum of ten of the PBX locations homed on the ***same switching center,*** using the thousands digit to segregate the different PBX locations.

(2) The NNX code assigned to one customer may also be assigned to another customer, provided that each of the customer locations sharing the NNX code is not homed on the same switching center. This requirement exists in order to identify the customer location in the AMA network sampling data taken on CCSA calls.

(3) The NNX code chosen for a customer location on a CCSA network can be any number, including any NNX code already used in the realm of the regular message network.

B. Network Dialing

2.04 CCSA stations at customer locations must have a means to gain access to the CCSA network. This is generally achieved by dialing an access code. As will be discussed in more detail later, stations directly terminated on the CCSA network require no access code.

2.05 Stations associated with centrex-CU, centrex-CO, and satellite facilities require an access code. The digit "8" is used as the access code from centrex-CU and centrex-CO locations. An access code plus the digit "8" is generally used from centrex-CU satellite locations.

2.06 Typical examples of station dialing for on-network calls are as follows:

- Centrex or main PBX

  DT+8+DT+NNX+XXXX

- Centrex-CU and -CO satellite PBX

  DT+AC+8+DT+NNX+XXXX

- Directly terminated station

  8+DT+NNX+XXXX

Note: The access code "8" may be omitted if it is automatically provided by the station class of service.

2.07 The examples shown in 2.06 are for on-network calls. When the optional universal service off-network access is subscribed by the customer and a calling network station desires an off-network (POTS) station, the POTS DDD address is used instead of the CCSA address. The call will be directed in part over the CCSA network to the CCSA switching center having an "off-net" access line (ONAL) to a local exchange. The call enters the DDD network via this access line and the local exchange.

2.08 Typical examples of station dialing for off-network calls are as follows:

- Centrex-CU or -CO

  DT+8+DT+NPA+NNX+XXXX

- Centrex-CO or -CU satellite PBX

  DT+AC+8+DT+NPA+NNX+XXXX

- Directly terminated station

  8+DT+NPA+NNX+XXXX (See note in 2.06.)

In the examples above, the numbering plan area (NPA) code is the DDD area code; the NNX is the DDD local exchange code; and the XXXX is the called subscriber line number.

2.09 A POTS station can call a CCSA station via the CCSA network by dialing the special DDD address code assigned to the CCSA off-network access line of the customer. The call will be routed to the network attendant who will complete the call to the CCSA station.

2.10 It may be desirable when off-network calling is provided, to restrict certain stations on a PBX from making off-network calls. This restriction is provided by two separate access line groups at the PBX; one group for on-network calls, the other group for off-network calls. The CCSA switching center where these access lines are terminated is then arranged to permit off-network calling only for the off-network access line group. At the PBX, only those stations allowed off-network calling can gain access to the off-network access line group by dialing a special access code. If the special access code is dialed from a restricted station, the restricted station will be denied access to the off-network access line group.

C. CCSA Networks

2.11 A CCSA network consists of strategically located switching centers interconnected by private trunk facilities. Each network has dedicated access lines and network trunks. The access lines give the customer access to network switching centers, and the network trunks interconnect the switching centers.

2.12 A hierarchical network configuration similar to the one used by the DDD network is used for CCSA networks. Figure 1 shows the 3-level hierarchical switching plan using 2- and 4-wire switching centers.

2.13 The CCSA network has the capability of providing many types of telephone and data service. Any service that is normally provided at a 2-wire PBX on the DDD network can be provided at the PBX by a CCSA network. Voice grade service over the CCSA network is comparable to private line service, since the number of trunks in tandem and their losses can be controlled to give a uniform grade of service.

2.14 Class SS1 switching centers are not provided unless customer requirements for circuit assurance or circuit economics indicate a need for them.

2.15 Secure voice can be handled over a CCSA network. Where this requirement exists, the type of switching and transmission facilities can be selected and specially conditioned to provide this service. Basically, this requires use of 4-wire subscriber or access lines from the secure voice stations and 4-wire network trunks between switching centers.

2.16 Off-network calls may originate or terminate in the DDD network and connect with a station of the CCSA network. To insure satisfactory transmission with this type of call, interconnection with the DDD network is limited to one point on each call. That is, a call which traverses the CCSA network should not originate and also terminate in the DDD network.

2.17 When a customer has scattered stations in an exchange area and a PBX is not justified,

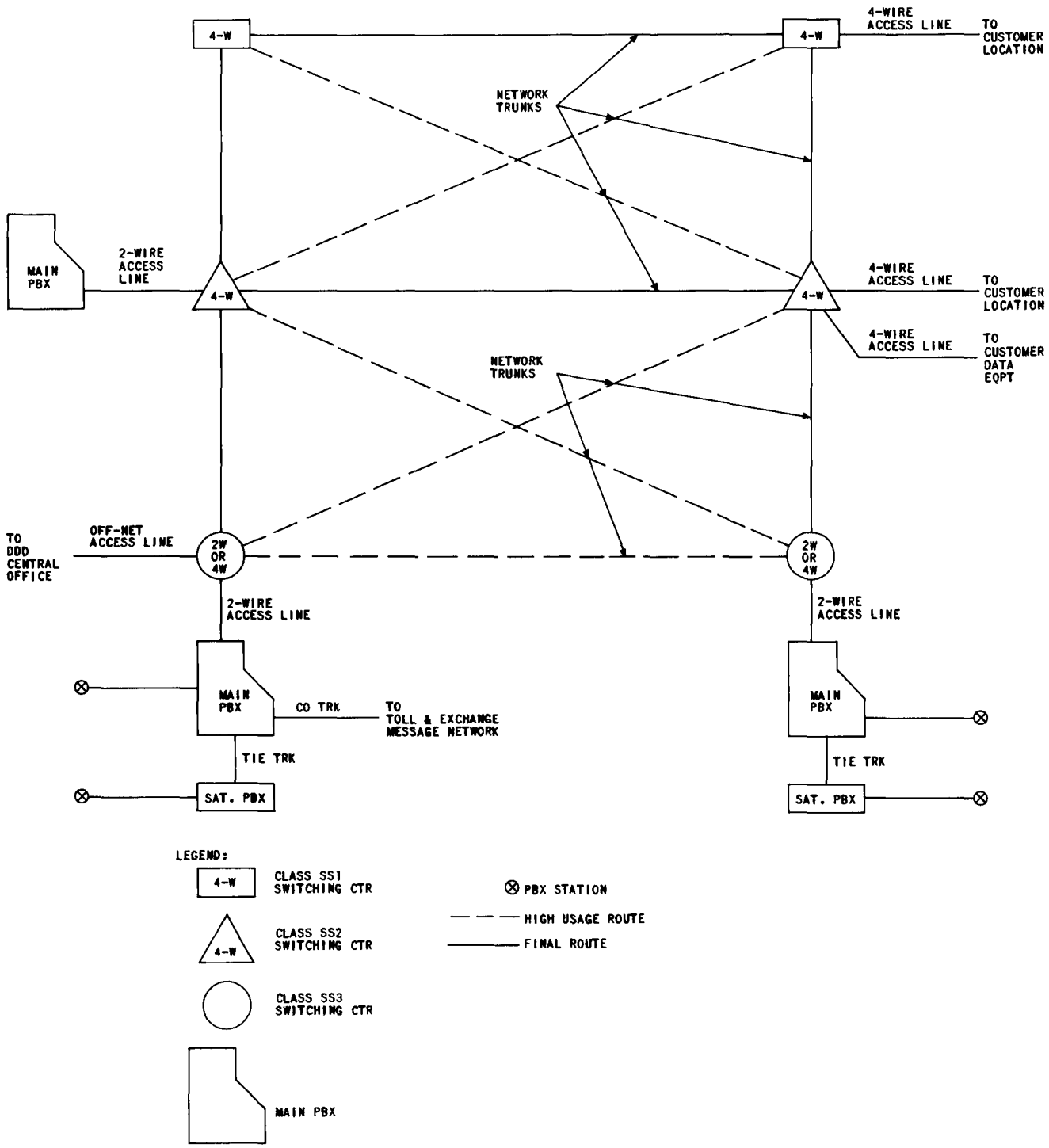

Fig. 1—3-Level Hierarchical Switching Plan

an off-network access line may be provided to that exchange area for CCSA calling to or from the customer location.

2.18 Figure 2 shows a typical CCSA network utilizing four switching centers.

D. Network Switching Centers

2.19 The network switching centers are 2-wire and 4-wire switching offices.

2.20 Each switching center involved with the completion of a call is classified according to its switching function. The class designations of an office determine the routing pattern of a call.

2.21 Class SS1 and SS2 switching centers are always 4-wire offices and are analogous to regional offices in the DDD network. This class switching center generally switches network trunks to network trunks.

2.22 Class SS3 switching centers may be either 2-wire or 4-wire switching centers. This class of switching center is analogous to a sectional center in the DDD network and serves to connect access lines from customer locations to network trunks. Since these switching facilities may also be used by other services, such as centrex-CO and

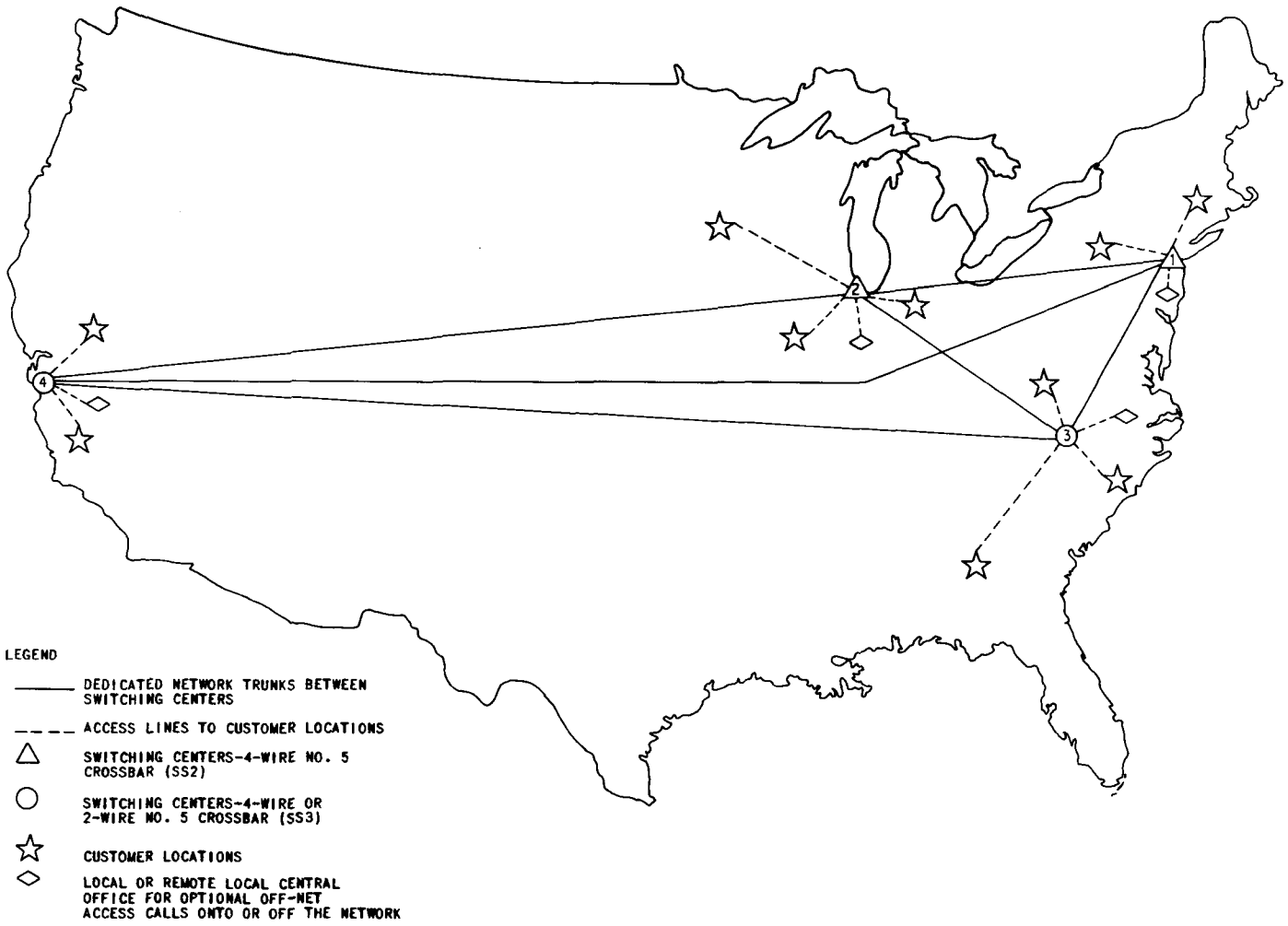

Fig. 2—CCSA Network Using Four Switching Centers

POTS, it is expected that the majority of the class SS3 switching centers will be of the 2-wire type.

2.23 Following is a summary of the requirements of the switching equipment in a CCSA switching center.

(a) Sufficient translating and screening capabilities to handle the anticipated CCSA traffic.

(b) Alternate routing capabilities to handle the anticipated CCSA traffic.

(c) Station number thousands digit translation for network calls when two or more PBXs are utilizing the same NNX code.

(d) Foreign area translation for selective routing arrangement when automatic off-network calling is to be provided from the switching center.

(e) Regular dial pulsing outsenders when automatic off-network calling is to be provided from the switching center.

(f) Ability to tandem-connect network trunks if class and type of switching centers require trunk-to-trunk connections.

(g) Provisions for obtaining an AMA sample on a maximum of 20 percent of the network calls originated in that switching center.

(h) Equipped with automatic identified outward dialing (AIOD) and local automatic message accounting (LAMA) when the switching center is providing CCSA service to a centrex-CU location. (The centrex-CU location must be equipped with PBX ANI facilities.)

(i) Equipped with traffic usage recording facilities to provide usage data for access line groups and network trunk groups for each CCSA customer using the switching center.

(j) Equipped with peg count and overflow registers to provide data on the access line groups for each CCSA customer using the switching center.

(k) Equipped with recorded announcement facilities to return a recorded announcement to a CCSA station that has dialed an unassigned or vacant NNX code.

(l) Equipped to supply standard tones to access lines or network trunks when (1) connection is completed to called station or operator, (2) call encounters a line number busy (3) no circuit available between customer location and switching center (4) no circuits available between CCSA switching centers, or (5) common control switching equipment busy at switching center.

(m) Equipped for TOUCH-TONE when customer locations served by switching center are equipped with TOUCH-TONE.

(n) Equipped with line link pulsing operation when switching center is 2-wire and serves access lines from PBX-type customer locations.

(o) Equipped with 4-wire LUNK operation when switching center is 4-wire and serves access lines from PBX-type customer locations.

(p) When a network customer is provided both centrex-CO and CCSA service from the same switching center marker group, the switching center must be equipped for the dial "8" feature, universal pad control, and access group controller.

E. Customer Facilities

2.24 Customer facilities will vary depending upon the type of service provided for regular telephone service.

2.25 The customer facilities most often encountered fall within the following categories:

(a) Centrex-CO

(b) Centrex-CU

(c) Series 100, 200, or 300 PBX service packages

(d) Manual PBX

(e) Key Systems

(f) Dial Intercom Systems

(g) Directly Terminated CCSA Network Stations.

2.26 All customer locations regardless of type must have access to the network. This is always provided by access lines with the exception of a centrex-CO collocated in the same marker group within the CCSA switching center and a satellite or tributary PBX. This arrangement requires an access group controller at the switching center. When a centrex-CO is not collocated in the same marker group and centrex-CO is a No. 5 crossbar office, a 2-way network trunk is used as an access line to the CCSA switching center.

2.27 All Centrex-CU locations, main PBX locations, key systems, dial intercom systems, and directly terminated stations require access lines to the CCSA network.

F. Automatic Message Accounting (AMA) Traffic Sampling

2.28 Each switching center must have facilities for counting the network calls entering the network(s) from that center. A maximum of 20 percent of these calls must undergo automatic message accounting. A traffic sampling counter is used in the originating switching center to count all originating network calls and cause an AMA tape entry for a maximum of 20 percent of these calls. The AMA entries on the tape will identify the customer by access line. When the customer location is served by a centrex-CO or centrex-CU, the AMA tape will identify the calling station.

2.29 There is a maximum of 30 office indexes in each marker group in a No. 5 crossbar switching center. Since many CCSA switching centers also provide regular message network service to POTS customers, the AMA equipment will be shared between the network and POTS customer. Therefore, the central office indexes (COIs) are used to identify both CCSA network customers and POTS customers.

2.30 The relationship between the CCSA number assignment and the AMA entries for (typical) CCSA customers is shown in Table B.

G. Off-Network Calling Arrangement (Universal Service)

2.31 Off-network calling is provided when the customer subscribes to the optional universal service. This arrangement is available in both 2- and 4-wire switching centers either as one- or two-way operation.

2.32 Off-network access lines are required for off-network calling. These access lines consist of off-network access lines (ONAL) and local off-network access lines (LONAL). The ONAL is used between the CCSA switching center and a remote local central office on the DDD network; the LONAL is used as a junctor when the switching center is used for both CCSA network service and regular message network service on the DDD network.

2.33 Network customers desiring to call off-network gain access to the CCSA network, then dial the 10-digit DDD address of the called regular message network station. An example is:

DT+8 + DT + NPA + NNX + XXXX

The call will be directed via the CCSA network to the switching center with off-network facilities closest to the NPA being called. If after leaving the CCSA network, the call involves intertoll facilities, AMA will be made on only that leg of the connection using the intertoll facilities.

2.34 When required, AMA billing will be made against the calling station for that portion of the connection not involving the CCSA facilities.

2.35 The off-network calling arrangement also provides for calls to be made from DDD network stations to stations on a CCSA network. A station in the DDD network desiring access to a station on the CCSA network would dial a 7- or 10-digit directory number of an auxiliary line circuit in a local central office or the CCSA switching center, if the switching center also provides regular message network service. When the auxiliary line circuit is seized by a calling DDD station, an attendant at the CCSA customer location is connected to the calling station. After receiving the called CCSA address from the calling DDD station, the attendant completes the call.

2.36 The attendant will either be the centrex-CO attendant, when the switching center is collocated with centrex, or a remote attendant.

2.37 A CCSA customer may also subscribe to optional wide area telephone service (WATS).

TABLE B

AMA ENTRY ASSIGNMENTS (TYPICAL)

	TYPE OF CUSTOMER LOCATION FOR CUSTOMER A (NOTE 1)		CCSA ADDRESS	CENTRAL OFFICE BILLING INDEX (NOTE 2)	AMA TAPE ENTRY	CUSTOMER PRINT OUT	REMARKS
1.	Directly Terminated Line or Manual PBX Access Line		542-1234	1	1234	542-1234	542 is NNX Code Assigned to Switching Center for Directly Term. Lines
2.	Dial PBX — Identification of Access Line Group From PBX	PBX (A)	624-XXXX	2	6240	624-0000	Nonshared NNX Code
		PBX (B) PBX (C) PBX (D)	625-3XXX 625-4XXX 625-5XXX	3 3 3	6253 6254 6255	625-3000 625-4000 625-5000	Shared NNX Code
3.	Centrex-CU W/O ANI-AIOD — Identification of Access Line Group From Centrex PBX	CTX (A)	626-XXXX	4	6260	626-0000	Nonshared NNX Code
		CTX (B) CTX (C)	627-2XXX 627-3XXX	5 5	6272 6273	627-2000 627-3000	Shared NNX Code
4.	Centrex-CU W/ ANI-AIOD — Identification of Station at Centrex PBX	CTX (A) CTX (A)	628-5439 628-2724	6 6	5439 2724	628-5439 628-2724	Nonshared NNX Code
		CTX (B) CTX (B) CTX (C) CTX (C)	629-3242 629-3473 629-4242 629-4473	7 7 7 7	3242 3473 4242 4473	629-3242 629-3473 629-4242 629-4473	Shared NNX Code
5.	No. 5 Centrex-CO — Identification of Station	CTX (A) CTX (A)	623-1234 623-2345	8 8	1234 2345	623-1234 623-2345	Shared NNX Code

Note 1: Since the NNX code assignments for Customer B would be different, additional COIs must be assigned for customer B to identify the conditions 1-5 described for Customer A.

Note 2: The COI assignments are typical only. Assignments of particular COIs should be coordinated with the Local Accounting Group.

WATS service can be either "full time" or "measured time" WATS. Route advance from full time WATS to measured time WATS can be provided on a local basis, provided all the WATS trunks are in the same WATS band.

2.38 The attendant at a CCSA customer location gains access to a WATS trunk by switched access circuits. Attendants never have direct access to WATS trunks terminated on a CCSA switching center.

H. Data Connections

2.39 An arrangement for 2-wire switching centers is available which permits access to customer data facilities from both data stations on the CCSA network and data stations on the DDD network.

2.40 A free trunk circuit is used in the switching center to connect to the customer-on-premise data set. The free trunk has both a line-link and trunk-link appearance in the switching center. The line-link appearance is used to terminate incoming calls from distant CCSA switching centers or from the DDD network. The trunk-link appearance is used to complete outgoing calls from a locally terminated customer data station on the line-link frame.

2.41 A locally terminated data station can gain access to another local data station via the free trunk-link appearance by dialing a 1XX code. A distant CCSA network data station gains access to the same data station via the free trunk line-link appearance by dialing the one-digit CCSA address for that station. A distant DDD network data station gains access in the same manner as the distant CCSA data station but must first gain access to the CCSA network as discussed in 2.31 through 2.38.

I. TOUCH-TONE

2.42 Certain CCSA customers subscribe to TOUCH-TONE service with regular telephone service. When this condition is encountered, the CCSA office serving these customer locations should be arranged for TOUCH-TONE operation. In some special cases, converters at the customer locations can be used in lieu of the switching center being arranged for TOUCH-TONE. Each case is handled on a local basis with respect to the type of customer equipment encountered.

J. Collocated CCSA and Centrex-CO No. 5 Crossbar

2.43 In many cases a No. 5 crossbar office will be used as both a CCSA switching center and a centrex-CO for one customer. With this arrangement, there are no actual CCSA access lines from the customer location to the switching center as there would be for a dial PBX. Whether the customer location is serviced by a centrex-CO, dial-type PBX, or direct stations, a customer subscribes to a definite number of access lines from that location. In all cases except the collocated No. 5 centrex CCSA office, these access lines are physical circuits with only that quantity subscribed to provided. In the case of a collocated CCSA and centrex-CO, access from the centrex facilities to the CCSA network is simply via office linkage and interoffice trunks. An access group controller is required at the No. 5 crossbar office that is collocated CCSA and centrex-CO.

2.44 The access group controller (AGC) regulates the number of calls between the centrex-CO customer location and the CCSA network. The maximum number of simultaneous network access connections, both originating and terminating for the centrex-CO customer location, will be limited to the quantity of equivalent access lines required for that customer location. When the number of simultaneous calls reaches the number of access lines required, a fast busy signal is returned to any further call attempts.

3. CCSA EQUIPMENT ARRANGEMENTS—NO. 5 CROSSBAR OFFICE

3.01 This part describes in general the equipment arrangement required at both 2-wire and 4-wire No. 5 crossbar CCSA switching centers and the equipment arrangements at the customer location. Coverage includes only that equipment required to perform the CCSA switching function. Coverage for the equipment arrangements at the customer location is general in nature due to the variations that can be provided. For a more thorough understanding of the switching center and customer location equipment, reference should be made to the sections covering that equipment.

3.02 The equipment arrangement associated with 2-wire and 4-wire switching centers is described in the following paragraphs. Figure 3 shows the 2-wire switching center equipment in block diagram form and Fig. 4 shows the 4-wire switching center

equipment in block diagram form. When necessary, reference is made to other figures to show customer-located equipment and other equipment required to switch a CCSA call.

2-WAY NETWORK TRUNKS—2-WIRE

3.03 Two-way, 2-wire trunk circuits are available for terminating at 2-wire switching centers. When the switching center is also serving as a customer No. 5 centrex, the trunk provided is the type that can transfer incoming calls in accordance with the type of transfer the customer has subscribed to with the centrex service.

3.04 The trunk circuit, transmission, and signaling factilities provide any matching of these circuits to 4-wire circuits, if required, when interfacing with a distant switching center.

3.05 These 2-wire trunk circuits are designed to handle incoming calls on an MF basis, for terminating to CCSA access lines and to No. 5 centrex circuits, when the switching center is also serving as a customer No. 5 centrex. When the switching center is designated as an intermediate office in the network, these trunk circuits can be connected in tandem through to a distant switching center. When connected in tandem, MF pulsing is again used to pulse the distant end.

2-WAY NETWORK TRUNKS—4-WIRE

3.06 Two types of network trunk circuits are available for terminating at 4-wire switching centers. One type has a jack appearance at an attendant switchboard; the other circuit has no switchboard connection. In other respects the two trunk circuits are the same, in that they both provide 2-way operation for end-to-end 4-wire transmission. Transmission and signaling facilties provide any matching of 4-wire to 2-wire circuits, if required, when interfacing with a distant switching center.

3.07 Both types of network trunks are arranged for E&M signaling to the distant end and simplex signaling through the switching center switches. Pulsing is MF in both directions.

3.08 Tandem switched calls from one network trunk to another are routed through the line- link appearance of the incoming trunk to the trunk- link appearance of the outgoing trunk.

CCSA ACCESS LINES

3.09 Access lines interconnect the telephone equipment at the customer location with the switching center designated to serve that particular location. The number of access lines provided between any customer location and the switching center is determined by the amount of network traffic to be handled from that location.

3.10 The type of circuits used as access lines are chosen after giving consideration to the type of switching center, type of customer location requiring access, and the distance to the switching center. Following are six types of access lines described: Three for 2-wire switching centers and three for 4-wire switching centers.

A. 2-Way Line Circuit—Line Link Pulsing (LLP)—2-Wire

3.11 This circuit is used as an access line from a 2-wire switching center to a dial PBX having network-in-dialing (NID). The PBX may be a customer main PBX, or it may be a satellite PBX when the switching center is also serving as a customer No. 5 centrex.

3.12 On incoming calls this circuit functions as a line circuit. On outgoing calls a dial pulse sender is attached to outpulse the station digits. These digits are used to automatically switch the call to the called PBX station. The connecting circuit at the PBX (Figures 5 through 7) in most cases is a 2-way trunk circuit equipped with the necessary features for network-in-dialing.

B. 2-Way Access Trunk Circuit—2-Wire

3.13 This circuit is used as an access line for a remote No. 5 centrex when the remote centrex is serving a CCSA customer with centrex service. A network call originating at the remote centrex is connected to the 2-wire switching center using a 2-way trunk circuit at the remote centrex (Fig. 8) and the 2-way access trunk circuit at the switching center. This type of call is handled on a tandem or local completion basis. For tandem completion, when the call is to be switched by way of the network to a distant station, the line-link appearance of the access trunk is used to connect to a network trunk circuit. For local completion, when the call is to be switched to a local station served by access lines from this switching center,

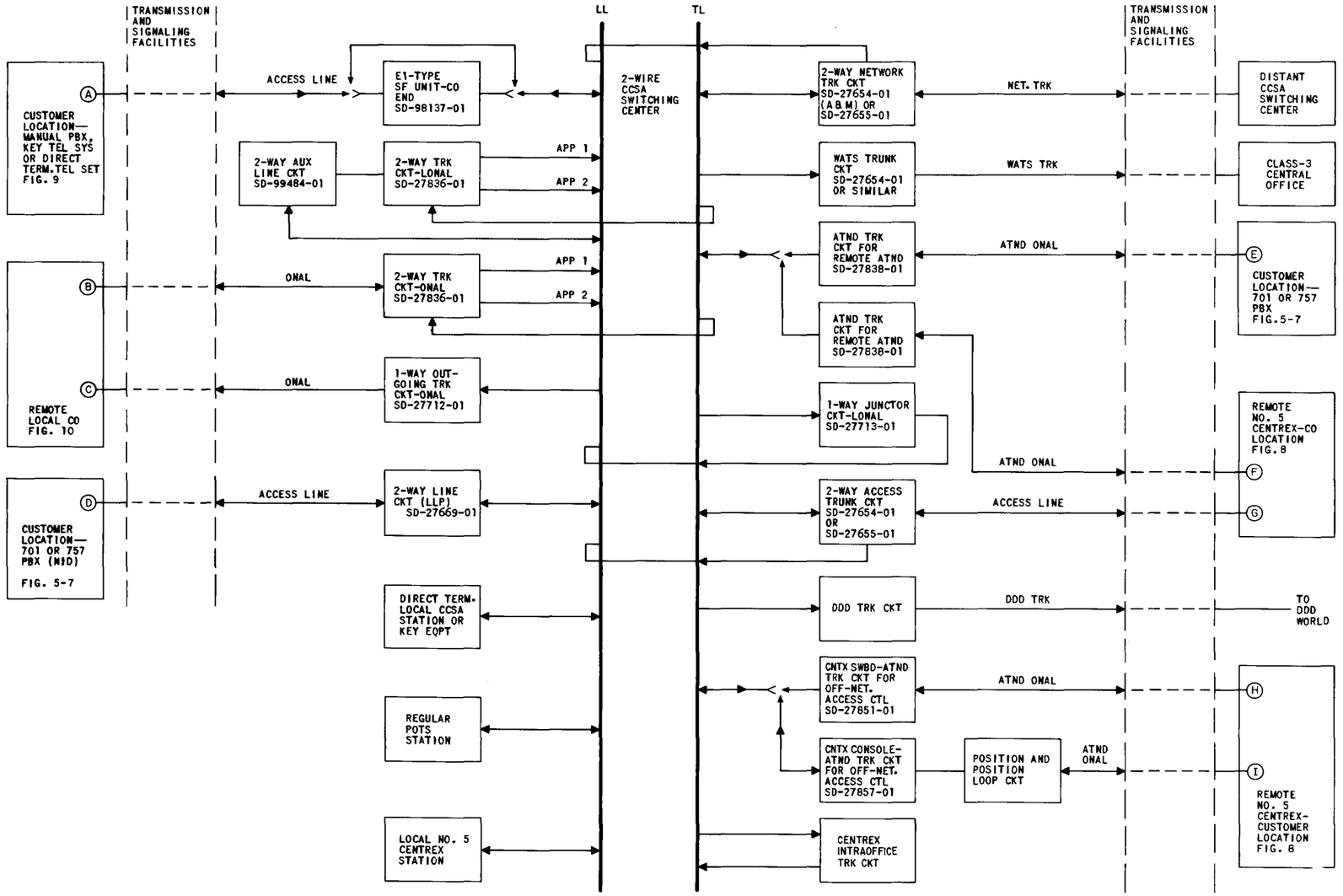

Fig. 3—2-Wire No. 5 Crossbar CCSA Switching Center—CCSA Equipment Arrangement

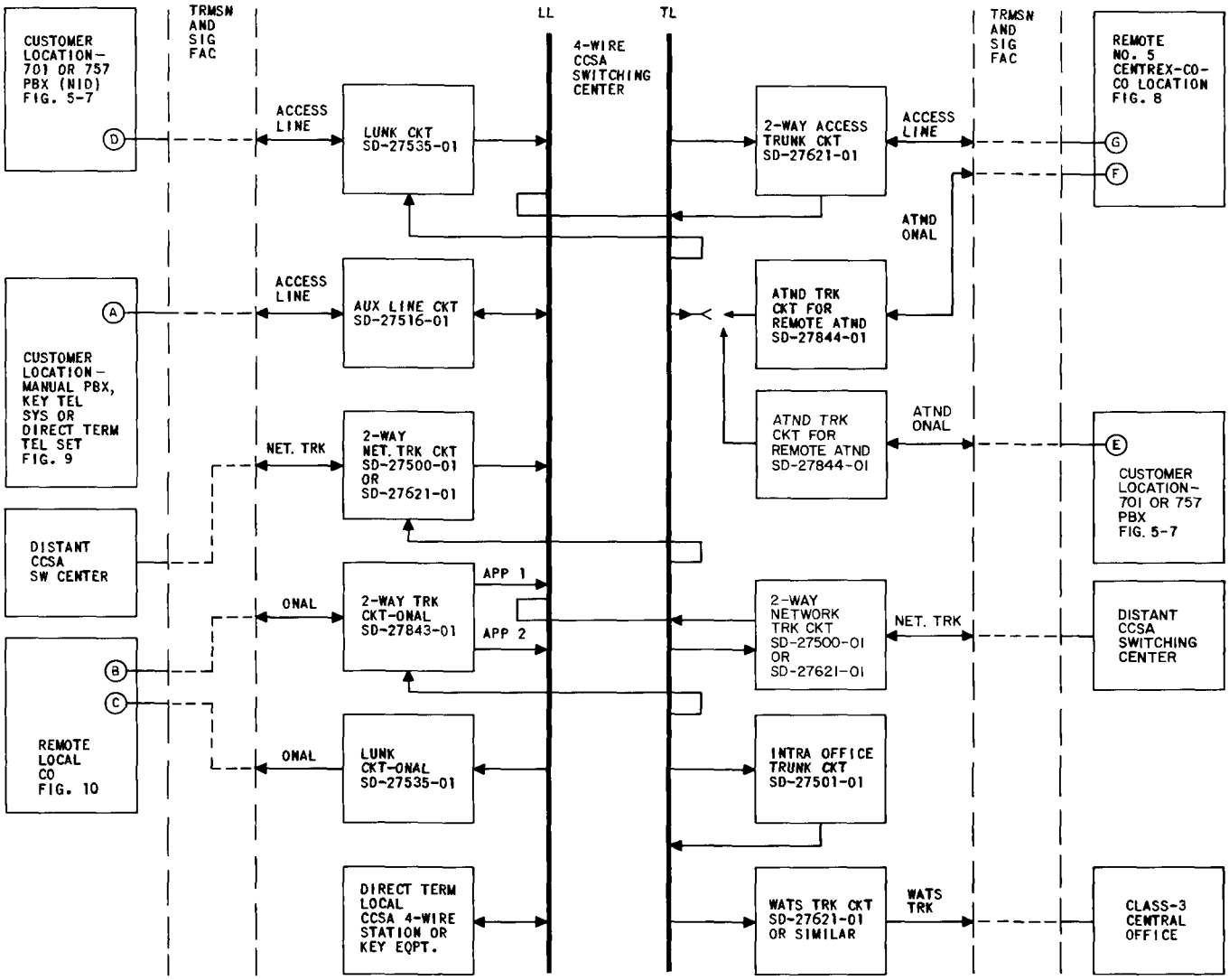

Fig. 4—4-Wire No. 5 Crossbar CCSA Switching Center—CCSA Equipment Arrangement

the trunk-link appearance of the access trunk connects to an access line serving the called station.

3.14 For incoming network calls to the remote No. 5 centrex, the trunk-link appearance of the access trunk is used.

C. Type E or F Single Frequency (SF) Unit—2-Wire

3.15 This type of circuit is used as an access line for CCSA stations, key equipment, or a manual PBX directly terminated at a 2-wire switching center. AC signaling is required between the switching center and the equipment at the customer location. When an SF unit is utilized at the switching center, an SF unit is also required at the customer location (Fig. 9).

D. LUNK Circuit—4-Wire

3.16 This circuit is a 2-way trunk circuit with both a line-link and trunk-link appearance. It provides 2-way access from a 4-wire switching center to a dial PBX having network-in-dialing (NID).

3.17 This circuit completes network calls directly to the PBX extension and from the PBX to the 4-wire switching center by connecting to a

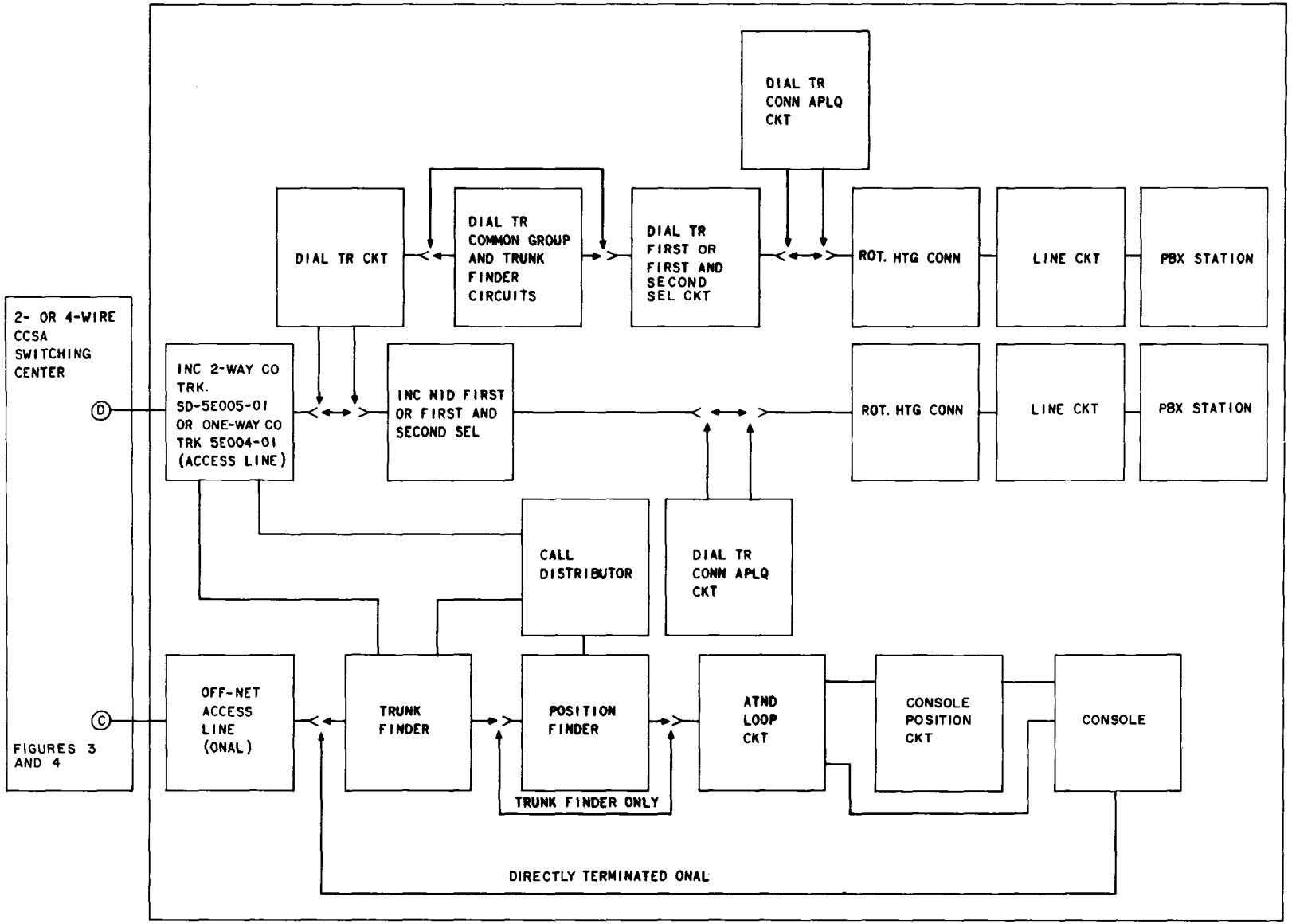

Fig. 5—701B PBX—Network Inward Dialing—Switched Loop Operation—Console as Attendant Facility—Equipment Arrangement

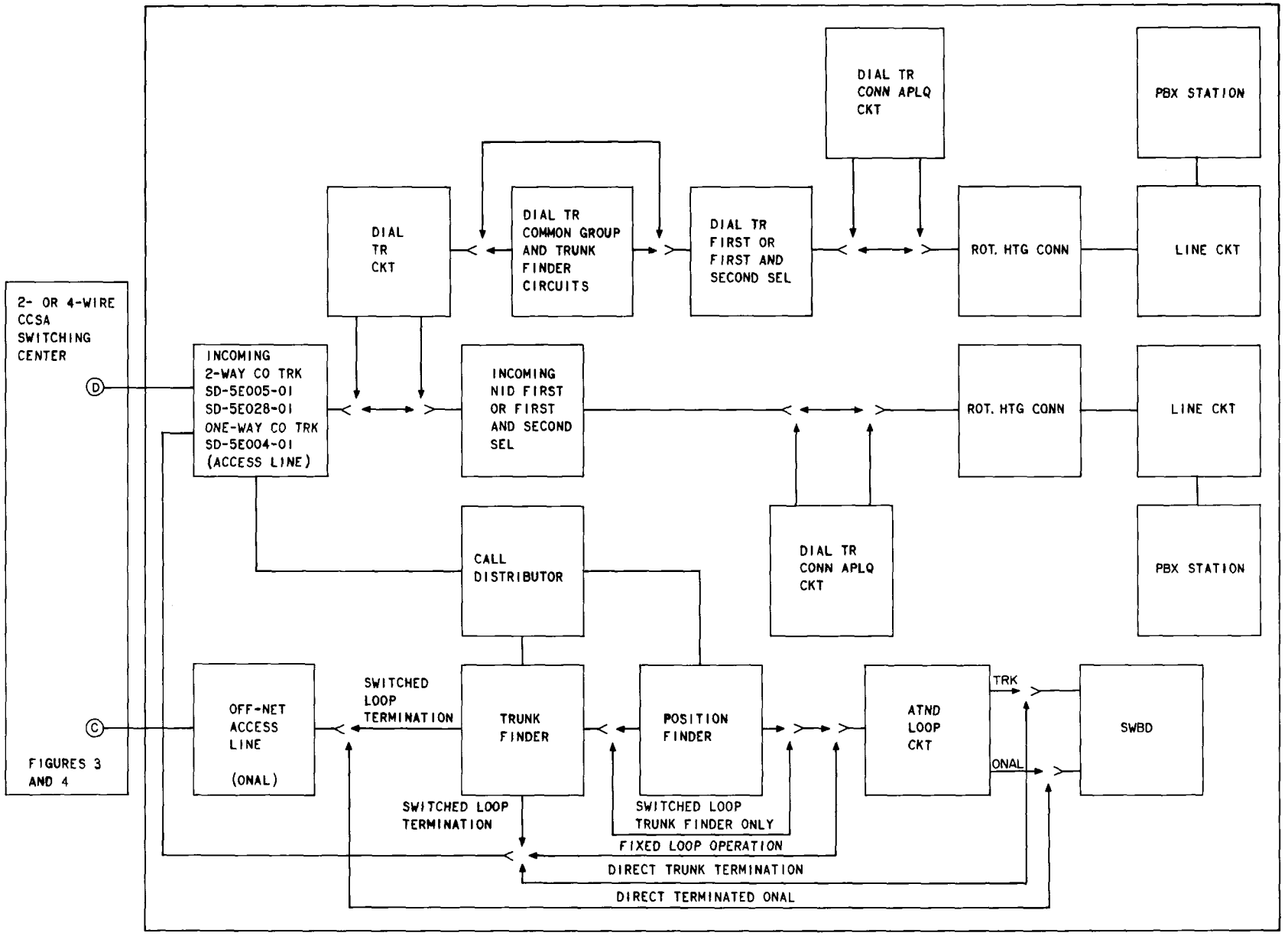

Fig. 6—701-Type PBX—Network Inward Dialing—Switched Loop, Fixed Loop, or Direct Trunk Termination Switchboard Used as Attendant Facility—Equipment Arrangement

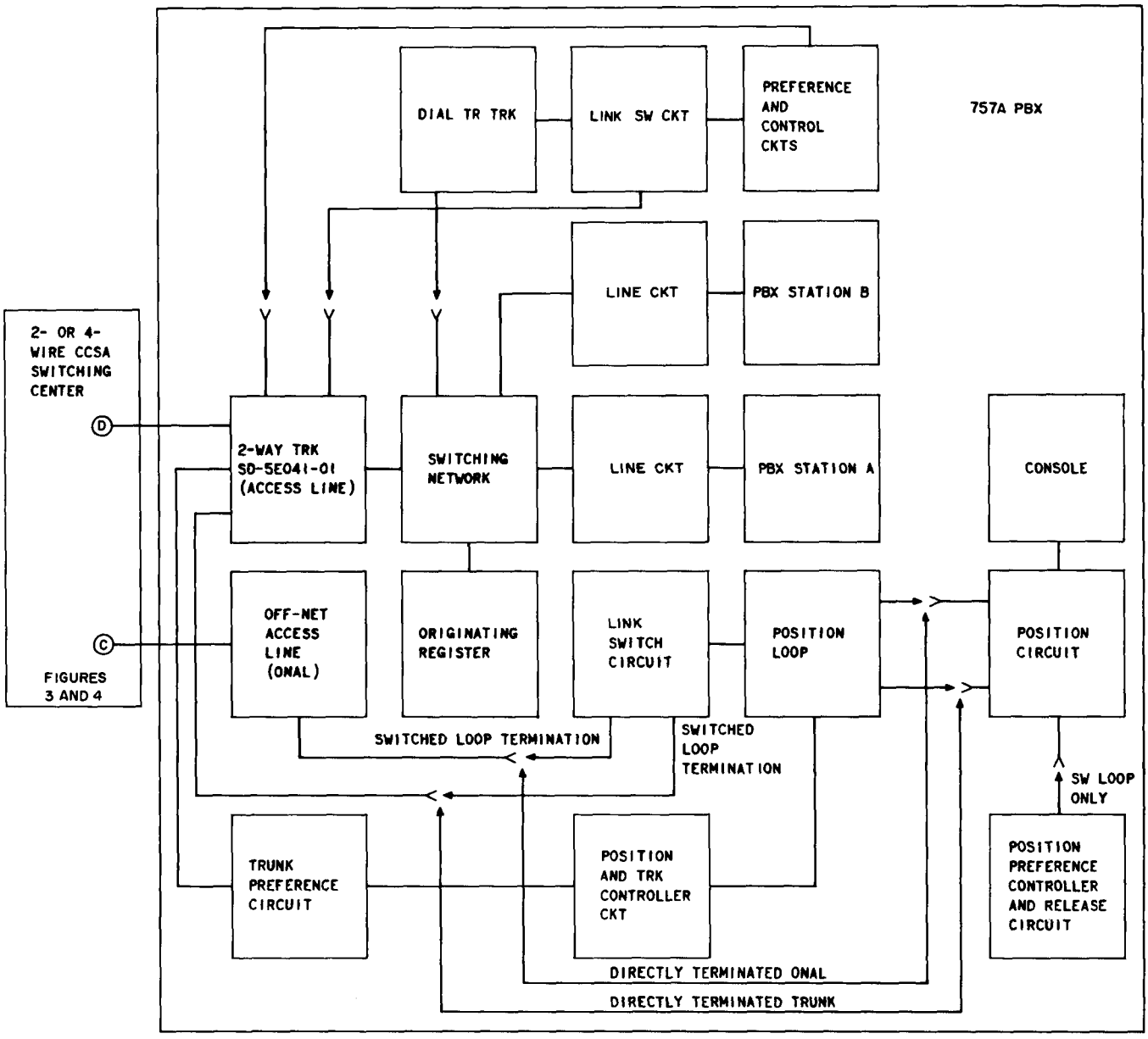

Fig. 7—757A PBX-Network Inward Dialing With or Without Dial Transfer—Switched Loop or Direct Trunk Termination With Console as Attendant Facility—Equipment Arrangement

2-way trunk circuit at the PBX (Figures 5 through 7).

3.18 In the outgoing mode, this circuit will complete an outgoing call by way of its trunk-link appearance directly to the PBX station.

3.19 In the incoming mode, this circuit will complete an incoming call by way of its line-link appearance to a network trunk, intraoffice trunk, or attendant trunk depending upon the type of call.

E. Auxiliary Line Circuit—4-Wire

3.20 This circuit is a 2-way circuit. It provides 2-way access from a 4-wire switching center to a manual PBX, directly terminated telephone set, or a key telephone system (Fig. 9). When

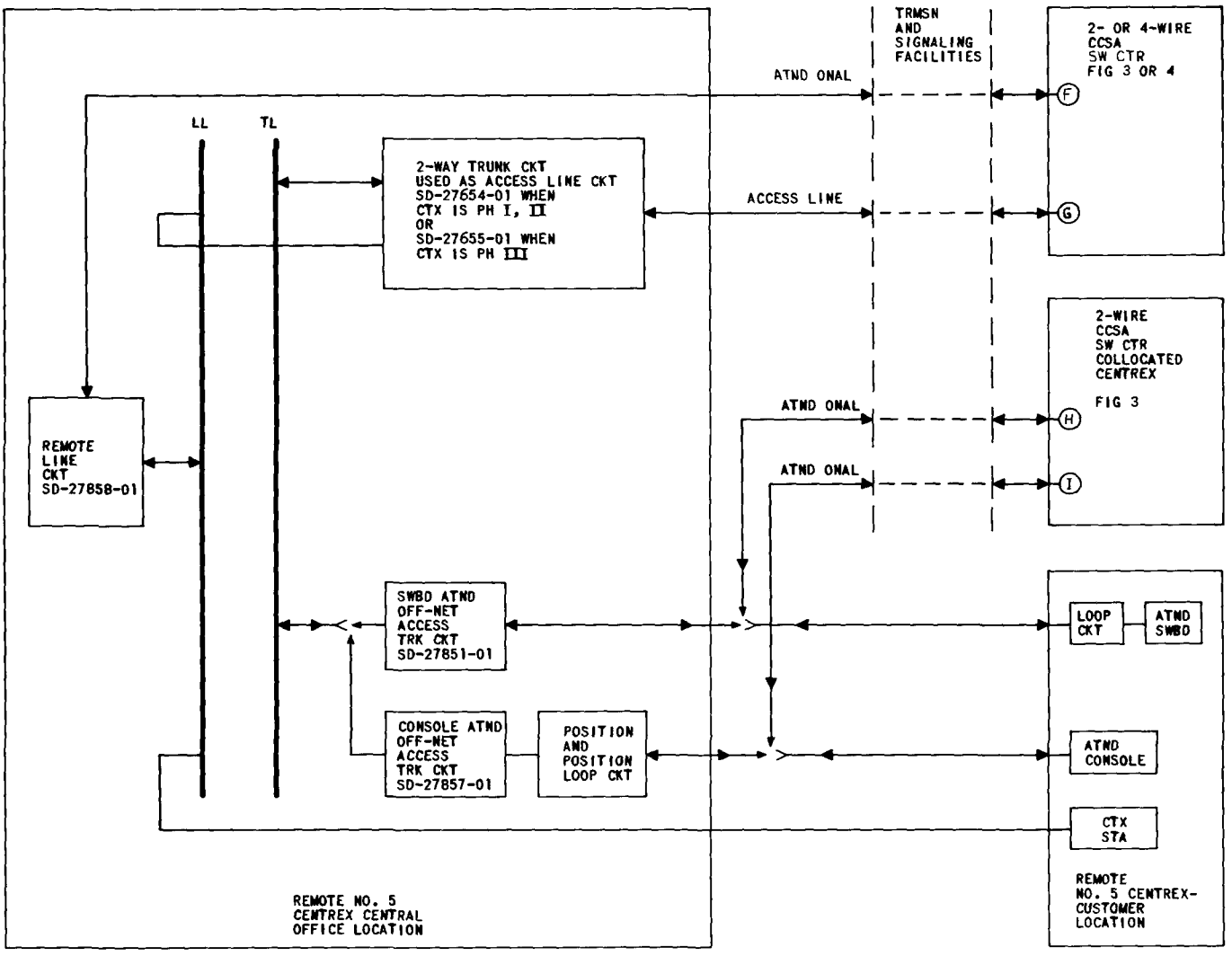

Fig. 8—Remote No. 5 Crossbar Centrex—CCSA Equipment Arrangement

this circuit is used as an access line, an auxiliary line circuit is also required at the far end.

F. 2-Way Access Trunk Circuit—4-Wire

3.21 This circuit provides the same service as the 2-way access trunk circuit used in a 2-wire switching center and is described in 3.13 and 3.14.

CCSA ATTENDANT OFF-NETWORK ACCESS LINES (ATND ONAL)

3.22 When a CCSA network customer subscribes to the universal service feature and, as part of this feature, calls from off-network stations (POTS stations) to CCSA stations are allowed, an ATND ONAL circuit is required at the switching center where these calls enter the CCSA network. This ATND ONAL circuit connects to an attendant at a customer location. All POTS to CCSA station calls are routed to the attendant using the ATND ONAL for completion onto the network.

3.23 The type of ATND ONAL circuit used is determined by the type of switching center and the location and type of attendant facilities provided at the customer location. Following are four types of ATND ONAL circuits described: Three for 2-wire switching centers and one for 4-wire switching centers.

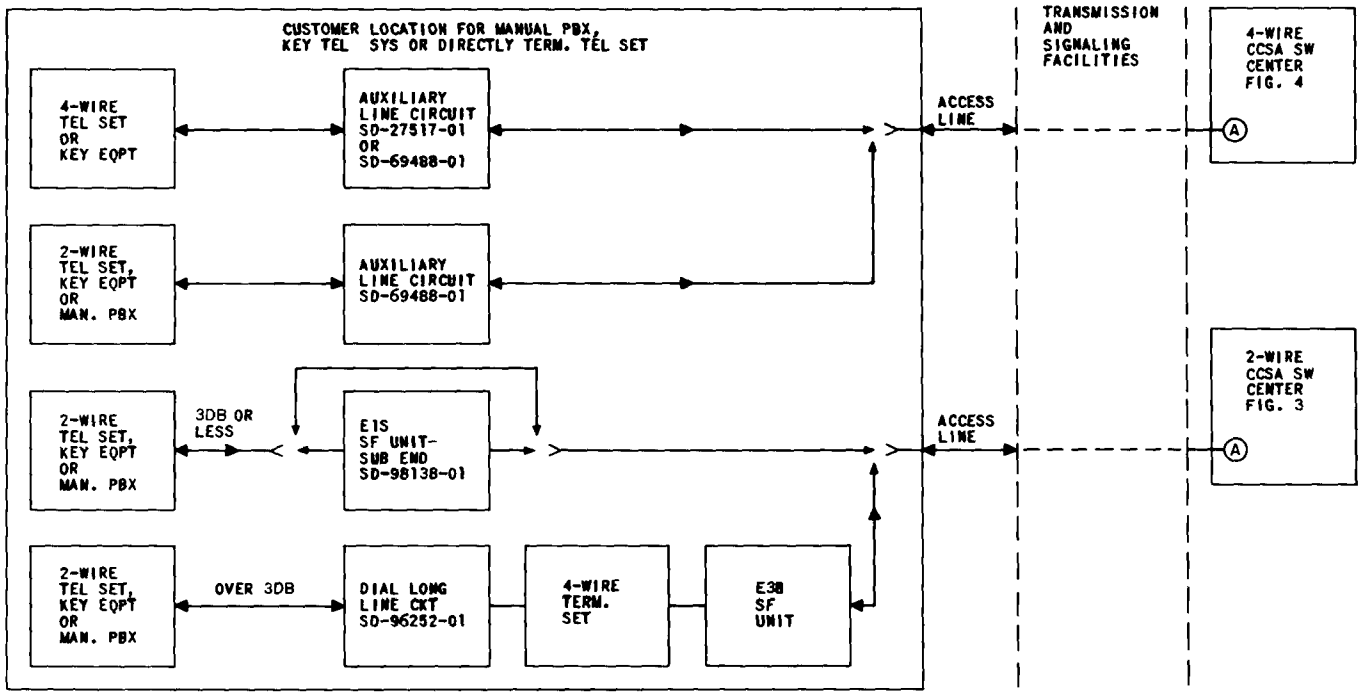

Fig. 9—Manual PBX, Key TEL SYS, or Directly Terminated TEL SET—CCSA Equipment Arrangement

A. Attendant Trunk Circuit for Remote Attendant—2-Wire

3.24 This attendant trunk circuit is used to connect from a 2-wire switching center to an ATND ONAL circuit at a PBX (Figures 5 through 7) or to a remote line circuit at a remote No. 5 centrex (Fig. 8).

B. Centrex Switchboard—Attendant Trunk Circuit for Off-Network Access Control—2-Wire

3.25 This attendant trunk circuit is used to connect to the attendant switchboard (Fig. 8) when the CCSA switching center is also a No. 5 centrex for the CCSA customer. This circuit is also used at a remote No. 5 centrex to connect to the attendant. In this case, connection to the remote centrex is by way of an attendant trunk circuit for remote attendant in the switching center and a remote line circuit at the remote centrex.

C. Centrex Console—Attendant Trunk Circuit for Off-Network Access Control—2-Wire

3.26 This attendant trunk circuit is used to connect to the attendant console (Fig. 8) when the CCSA switching center is also a No. 5 centrex for the CCSA customer. This circuit is also used at a remote No. 5 centrex to connect to the attendant. In this case, connection to the remote centrex is by way of an attendant trunk circuit for remote attendant in the switching center and a remote line circuit at the remote centrex.

D. Attendant Trunk Circuit for Remote Attendant—4-Wire

3.27 This circuit provides the same service as the ATND ONAL in a 2-wire switching center described in 3.24.

CCSA LOCAL OFF-NETWORK ACCESS LINES (LONAL)

3.28 When a CCSA network customer subscribes to the universal service feature and a 2-wire switching center on the network is also serving as a local central office for regular message network calls, the switching center may be designated as the stepping-off point for off-network calls. When this is the case, a LONAL circuit is required at the switching center. The LONAL circuit can be a one-way or 2-way circuit. The two types of LONAL circuits for 2-wire switching centers are described in the following paragraphs.

A. One-Way Junctor Circuit—LONAL—2-Wire

3.29 This one-way junctor circuit is used to connect a call from a CCSA customer to a POTS customer on the DDD network.

3.30 The trunk-link appearance of this circuit is seized for an off-network call, and the line-link appearance of this circuit connects to a DDD trunk for completion to the DDD network or an intraoffice trunk circuit when the called POTS station is terminated in the same switching center.

B. 2-Way Trunk Circuit—LONAL—2-Wire

3.31 This circuit provides 2-way off-network access service. It is used to connect calls from CCSA stations to POTS stations and from POTS stations to CCSA stations.

3.32 In the outgoing mode, CCSA calls via network trunks or access lines are switched through the LONAL using the LONAL trunk-link appearance. The LONAL circuit is connected back-to-back with a 2-way auxiliary line circuit having a line-link appearance. The call is switched from the line-link appearance of the auxiliary line circuit to a DDD trunk for completion to the DDD network or to an intraoffice trunk circuit, when the called POTS station is terminated in the same switching center.

3.33 In the incoming mode, a POTS originated call is switched to the line-link appearance of the auxiliary line circuit, seizing the back-to-back LONAL. The LONAL is switched to an attendant for completion of the call onto the CCSA network. In this mode the LONAL uses two line-link appearances; the first appearance for connecting to the attendant, the second appearance for connecting through to the called CCSA station.

CCSA OFF-NETWORK ACCESS LINES (ONAL)

3.34 When a CCSA network customer subscribes to the universal service feature, and off-network access to a remote local central office is to be provided, an ONAL circuit is required from a switching center to the local central office. The ONAL circuit can be a one-way or 2-way circuit. Following are four types of ONAL circuits described: Two for 2-wire switching centers and two for 4-wire switching centers.

A. One-Way Outgoing Trunk Circuit—ONAL—2-Wire

3.35 This one-way outgoing trunk circuit provides the same type of service as the one-way junctor circuit described in 3.29 and 3.30. Instead of performing as a junctor circuit within the same switching center, this circuit connects to a one-way ONAL circuit in a remote local central office (Fig. 10).

3.36 A call from a CCSA station to a POTS station is switched by way of this circuit to the one-way ONAL circuit at the remote local central office for completion to the POTS station on the DDD network.

B. 2-Way Trunk Circuit—ONAL—2-Wire

3.37 This 2-way trunk circuit provides the same type of service as the 2-way trunk circuit used as a LONAL described in 3.31 through 3.32, with the exception that off-network access is via

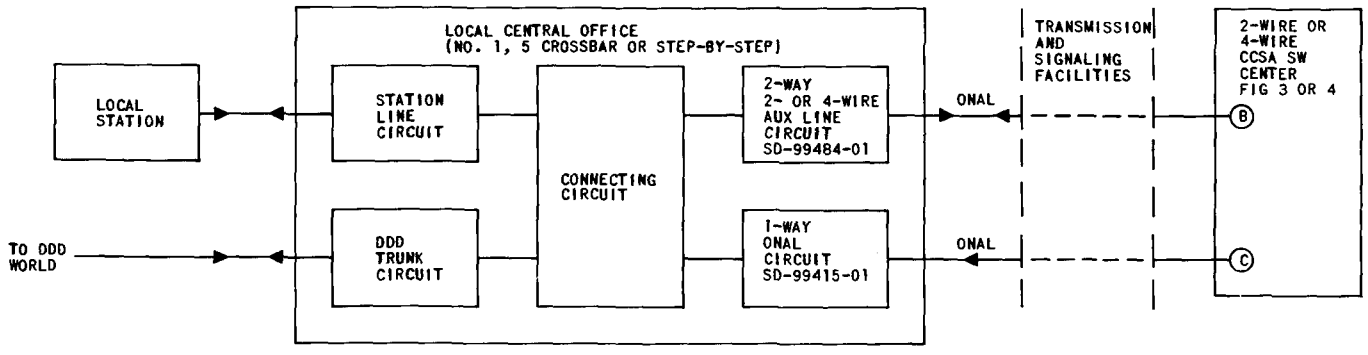

Fig. 10—Remote Local Central Office—Off-Network Calling—CCSA Equipment Arrangement

a remote local central office rather than the switching center. The ONAL circuit connects to an auxiliary line circuit located in the remote central office (Fig. 10).

3.38 In the outgoing mode, CCSA calls via network trunks or access lines are switched through the ONAL using its trunk-link appearance. The ONAL circuit is connected to the 2-way auxiliary line circuit in the remote local central office. At the remote local central office, the call is switched from the line-link appearance of the auxiliary line circuit to a DDD trunk for completion to the DDD network or to an intraoffice trunk circuit when the called POTS station is terminated in the same remote local central office.

3.39 In the incoming mode, a POTS originated call is switched to the line-link appearance of the auxiliary line circuit in the remote local central office. The auxiliary line circuit seizes the 2-way trunk circuit in the switching center causing an attendant to be connected for completion of the call onto the CCSA network. In this mode the ONAL uses two line-link appearances; the first appearance for connecting to the attendant, the second appearance for connecting through to the called CCSA station.

C. LUNK Circuit—ONAL—4-Wire

3.40 This circuit is used as a one-way ONAL to a remote local central office and is like the 2-wire ONAL which connects to a one-way ONAL at the remote local central office (Fig. 13). The 2-wire ONAL is described in 3.35 and 3.36.

D. 2-Way Trunk Circuit—ONAL—4-Wire

3.41 This 2-way trunk circuit provides 2-way off-network access service for CCSA stations to complete calls to POTS stations on the DDD network and for POTS stations to complete calls to CCSA stations by way of a 4-wire switching center.

3.42 In the outgoing mode, CCSA originated calls are switched through this ONAL using a trunk-link appearance to an auxiliary line circuit in a remote local central office (Fig. 10), designated as the stepping-off point for off-network calls.

3.43 In the incoming mode, POTS station originated calls via the auxiliary line circuit in the remote local central office are completed to this ONAL which causes an attendant to be attached for completing the call onto the CCSA network. In this mode the ONAL uses two line-link appearances; the first appearance to reach the attendant for screening, the second appearance to reach the called CCSA station by the attendant.

4. SWITCHING OF TYPICAL CALLS—NO. 5 CROSSBAR OFFICE

4.01 This part shows by use of simplified block diagrams, the switching of typical calls handled by a No. 5 crossbar CCSA switching network. Calls are handled on a similar basis by both 2-wire and 4-wire switching centers, although different types of circuits are used in some cases. The figures in this part are self descriptive and reflect the type of circuits used in both 2-wire and 4-wire switching centers.

A. On-Network Calls

4.02 Figure 11 shows the switched connections for a call originated from a CCSA station to a distant CCSA station via a network trunk and distant switching center.

4.03 Figure 12 shows the switched connections and equipment required at the destination switching center to handle a call terminating at a CCSA station.

B. Off-Network Calls

4.04 All off-network calls are switched through using an ONAL or LONAL circuit. Figures 13 through 15 show the switched connections for a typical call from the CCSA network to the DDD network at both 2-wire and 4-wire switching centers. Figures 16 through 18 show the switched connections for a typical call from the DDD network to the CCSA network; these calls require attendant completion.

4.05 Figure 19 shows the switched connections for a typical call from a CCSA station, either local or remote, to a distant class 3 central office using a WATS trunk circuit.

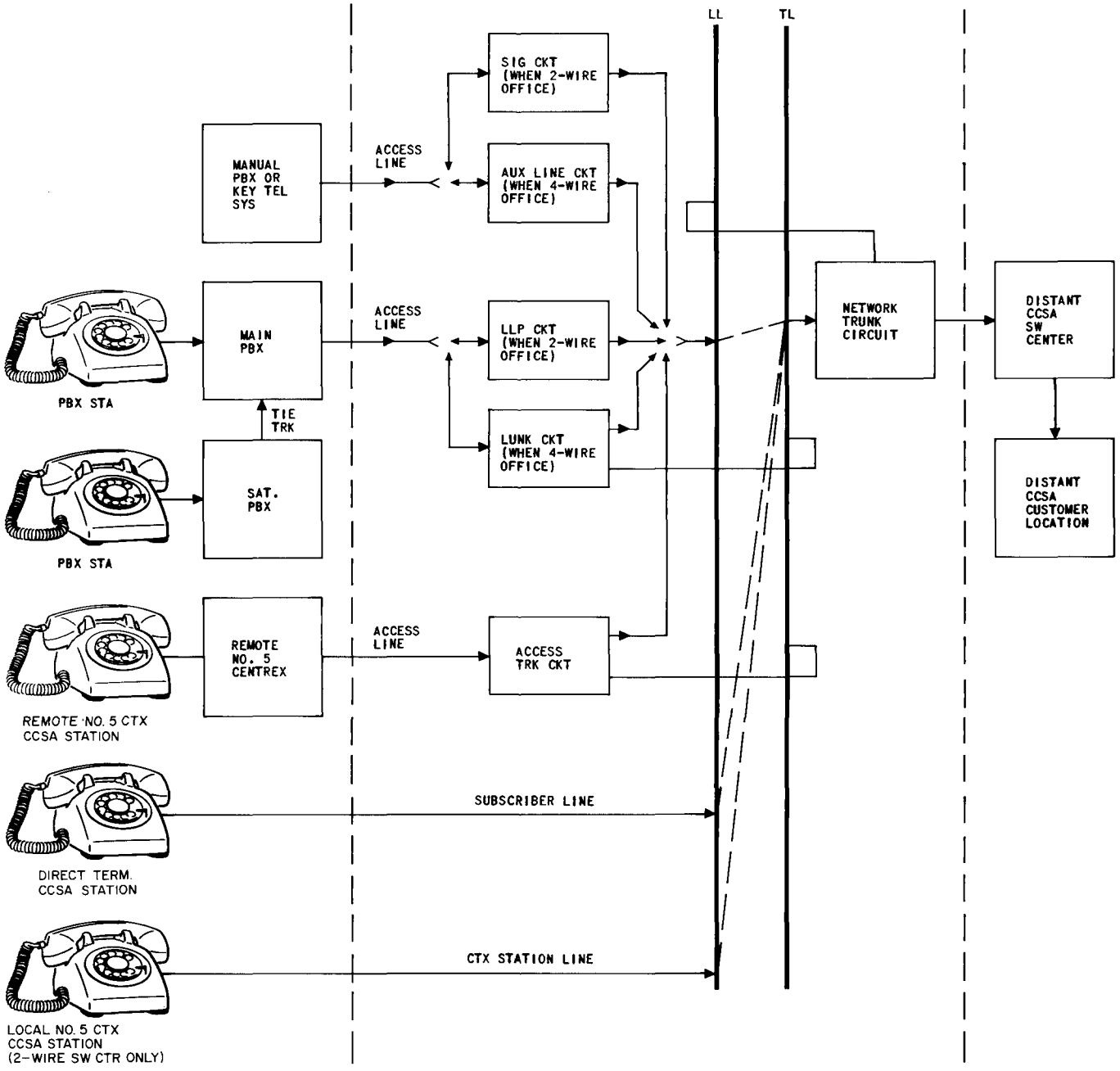

Fig. 11—Network Call From CCSA Station Via 2-Wire or 4-Wire No. 5 Crossbar Switching Center

5. MAINTENANCE AND TESTING ARRANGEMENTS—NO. 5 CROSSBAR OFFICE

5.01 The Master Test Frame (MTF) and associated Automatic Monitor Register Sender Test (AMRST) Frame have been arranged to test CCSA circuits and features for on- and off-network calling. In addition, connections have been provided for terminating the CCSA network trunk circuits at the 17E testboard in a 2-wire switching center and a 19A testboard in a 4-wire switching center for manual testing.

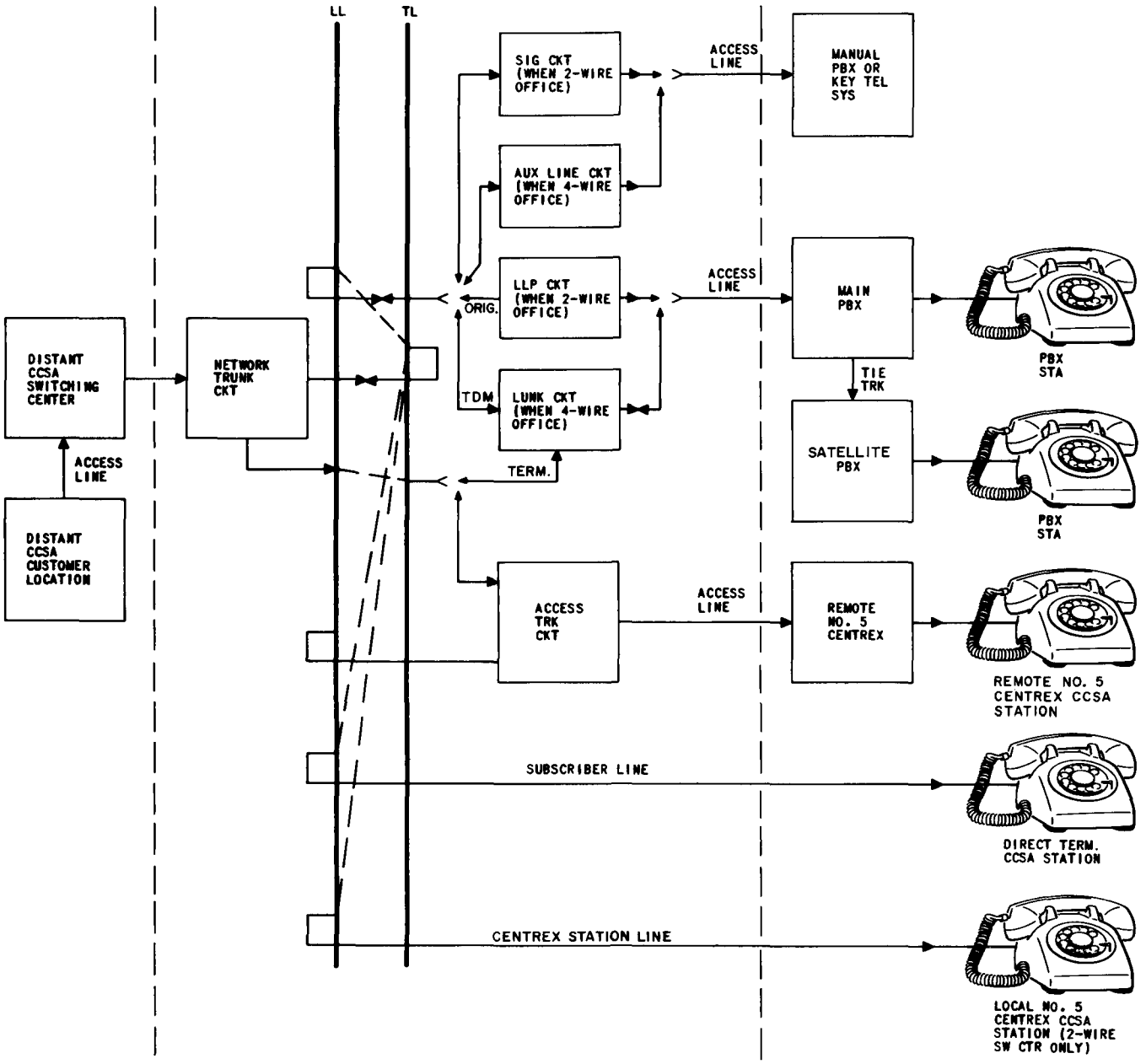

Fig. 12—Network Call to CCSA Station Via 2-Wire or 4-Wire No. 5 Crossbar Switching Center

5.02 The Automatic Progression Trunk Test Frame (APTT) has been arranged for directing outgoing trunk-type operational tests on line-link pulsing circuits, LUNK circuits, ONAL and LONAL circuits, and network trunk circuits, in both 2-wire and 4-wire switching centers.

5.03 For additional general information covering maintenance and testing facilities, refer to the associated Bell System Practices in division 958.

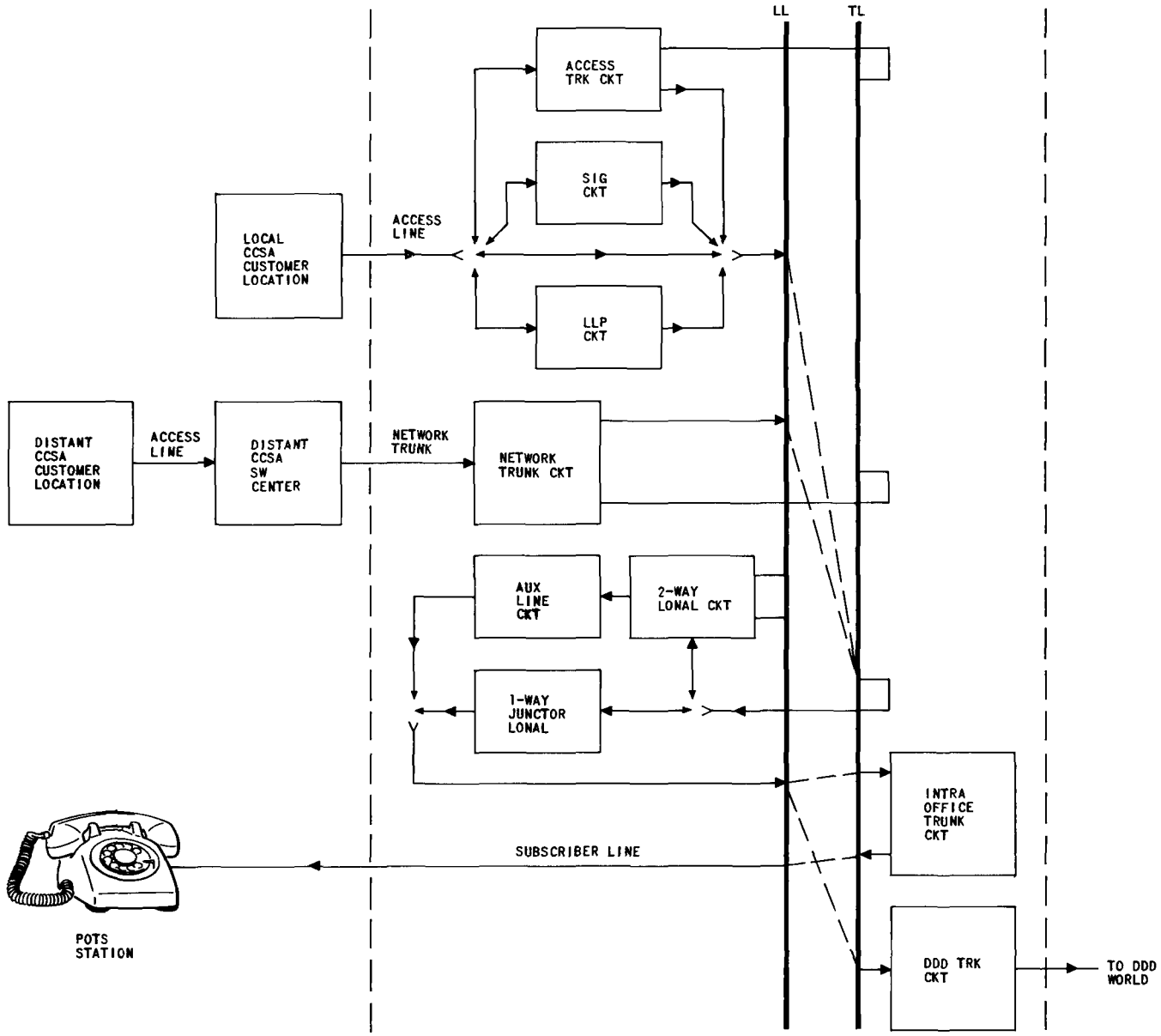

Fig. 13—Off-Network Call—CCSA to DDD Via LONAL 2-Wire No. 5 Crossbar Switching Center

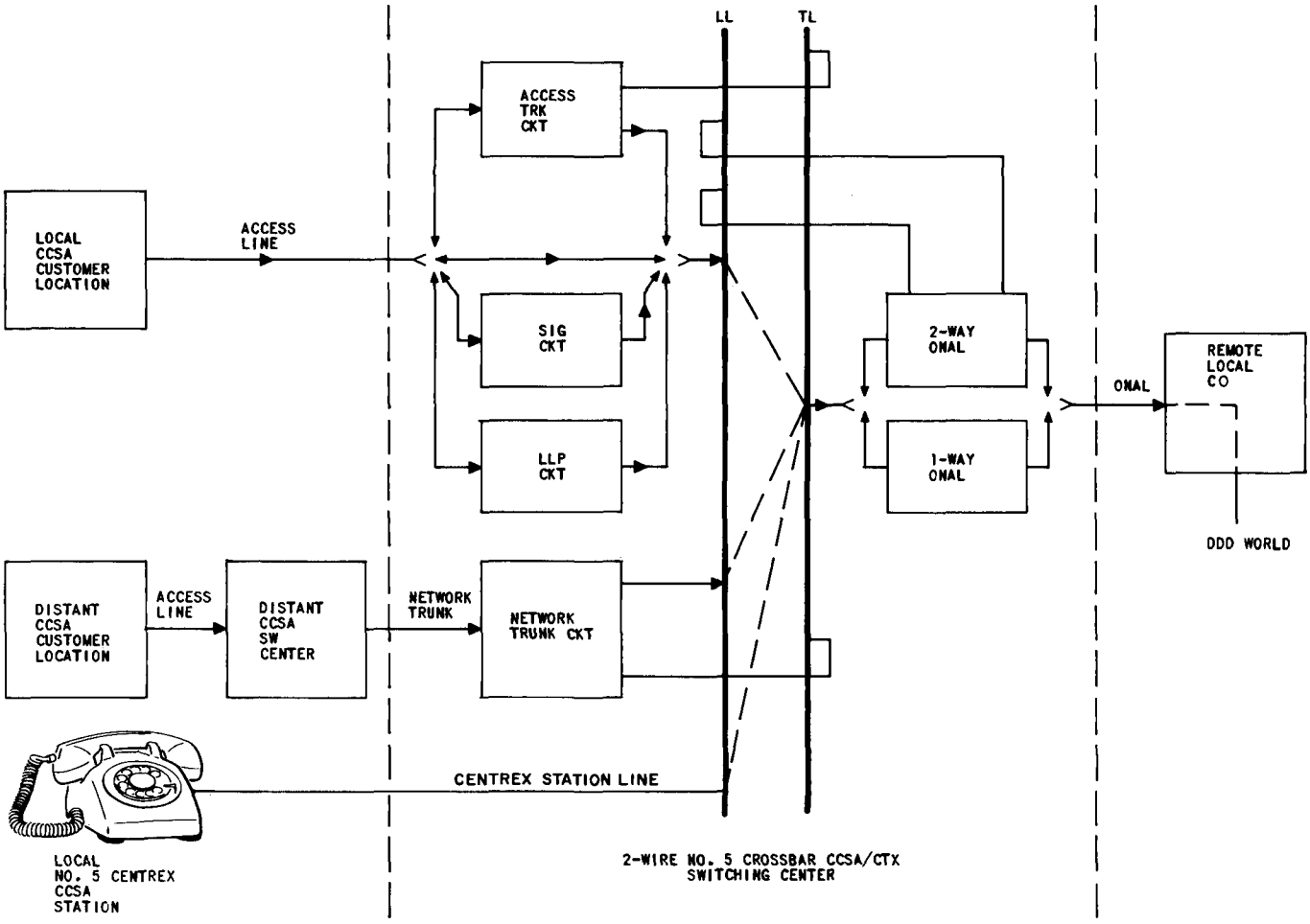

Fig. 14—Off-Network Call—CCSA to DDD Via ONAL 2-Wire No. 5 Crossbar Switching Center

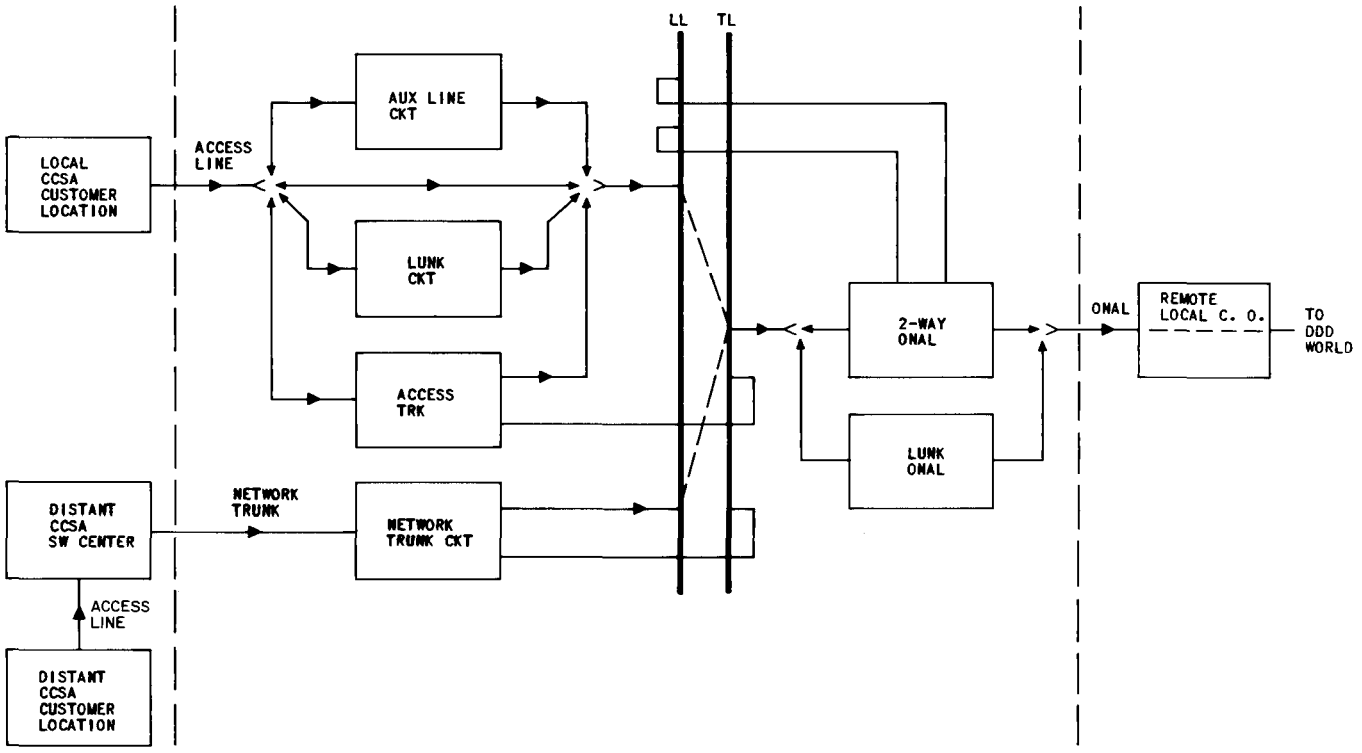

Fig. 15—Off-Network Call—CCSA to DDD Via ONAL 4-Wire No. 5 Crossbar Switching Center

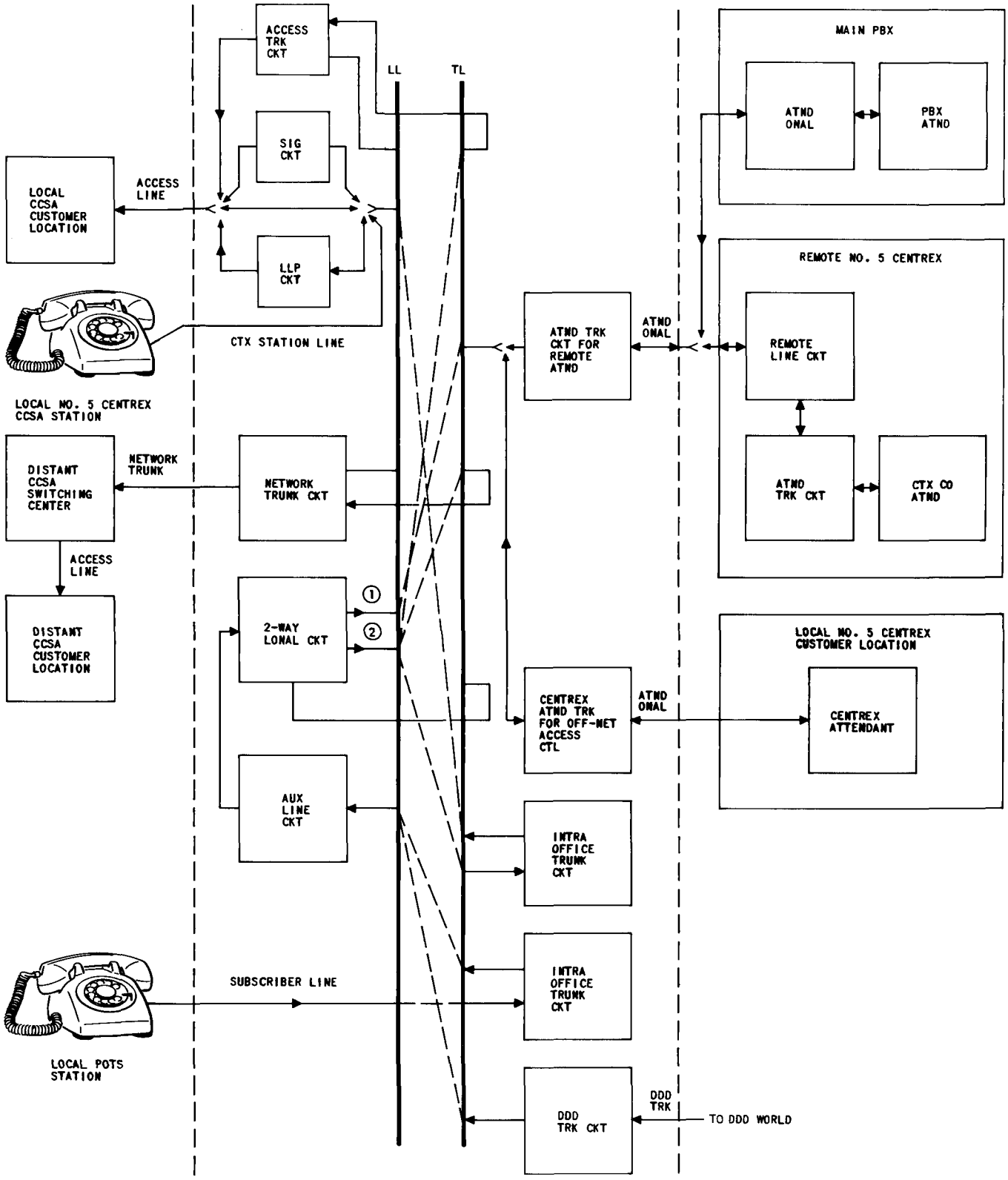

Fig. 16—Off-Network Call—DDD to CCSA Via LONAL 2-Wire No. 5 Crossbar Switching Center

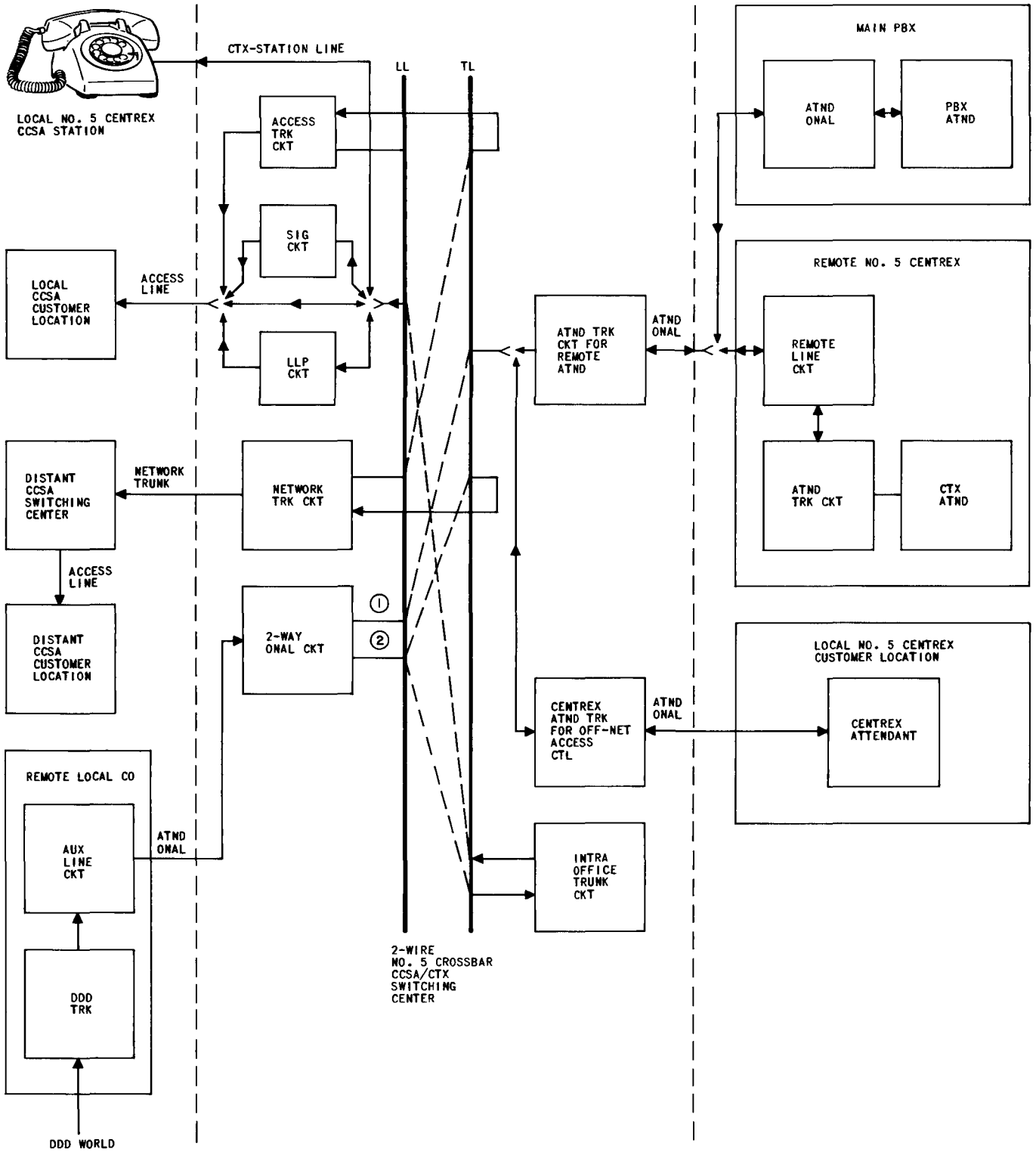

Fig. 17—Off-Network Call—DDD to CCSA Via ONAL 2-Wire No. 5 Crossbar Switching Center

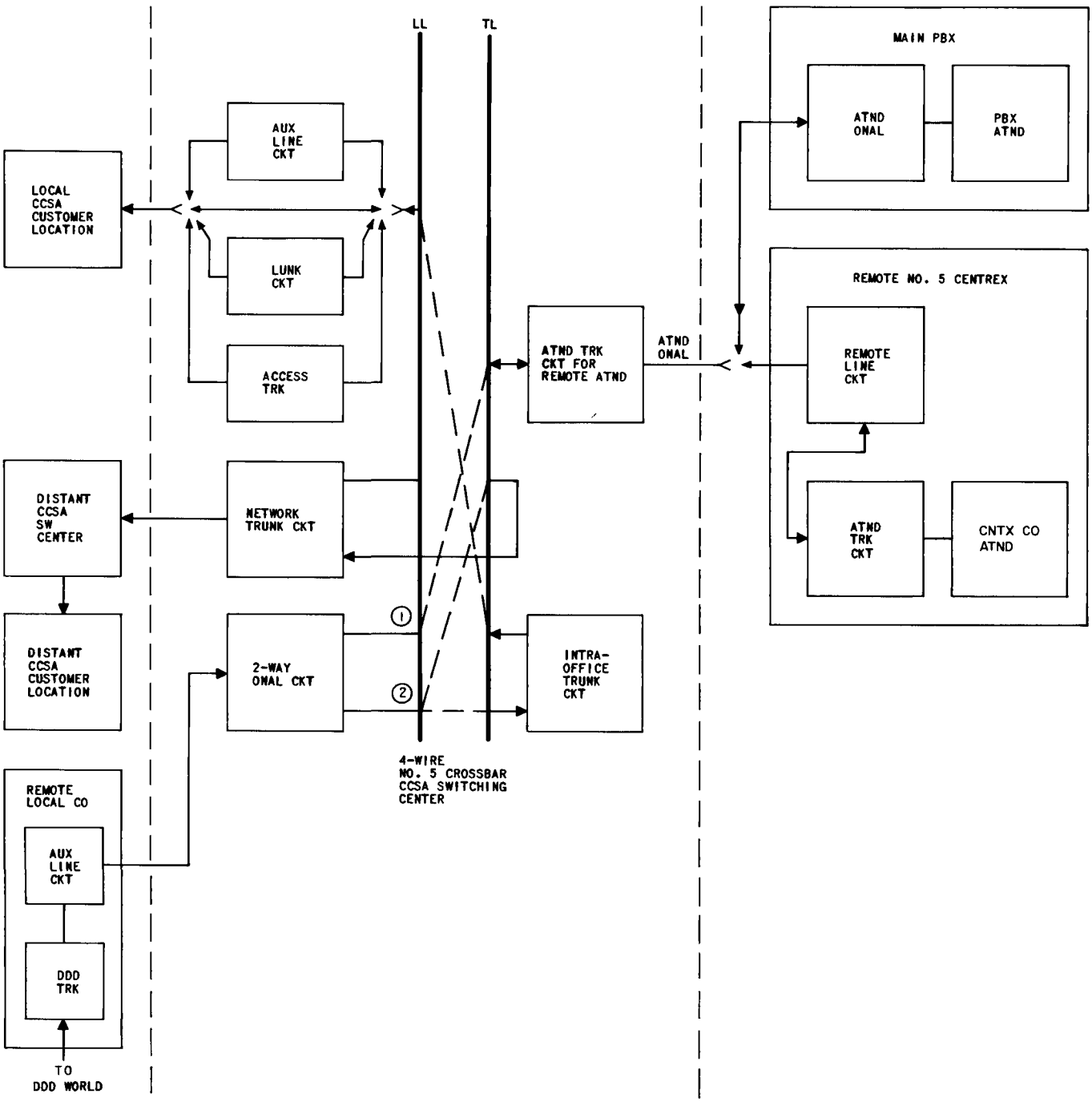

Fig. 18—Off-Network Call—DDD to CCSA Via ONAL 4-Wire No. 5 Crossbar Switching Center

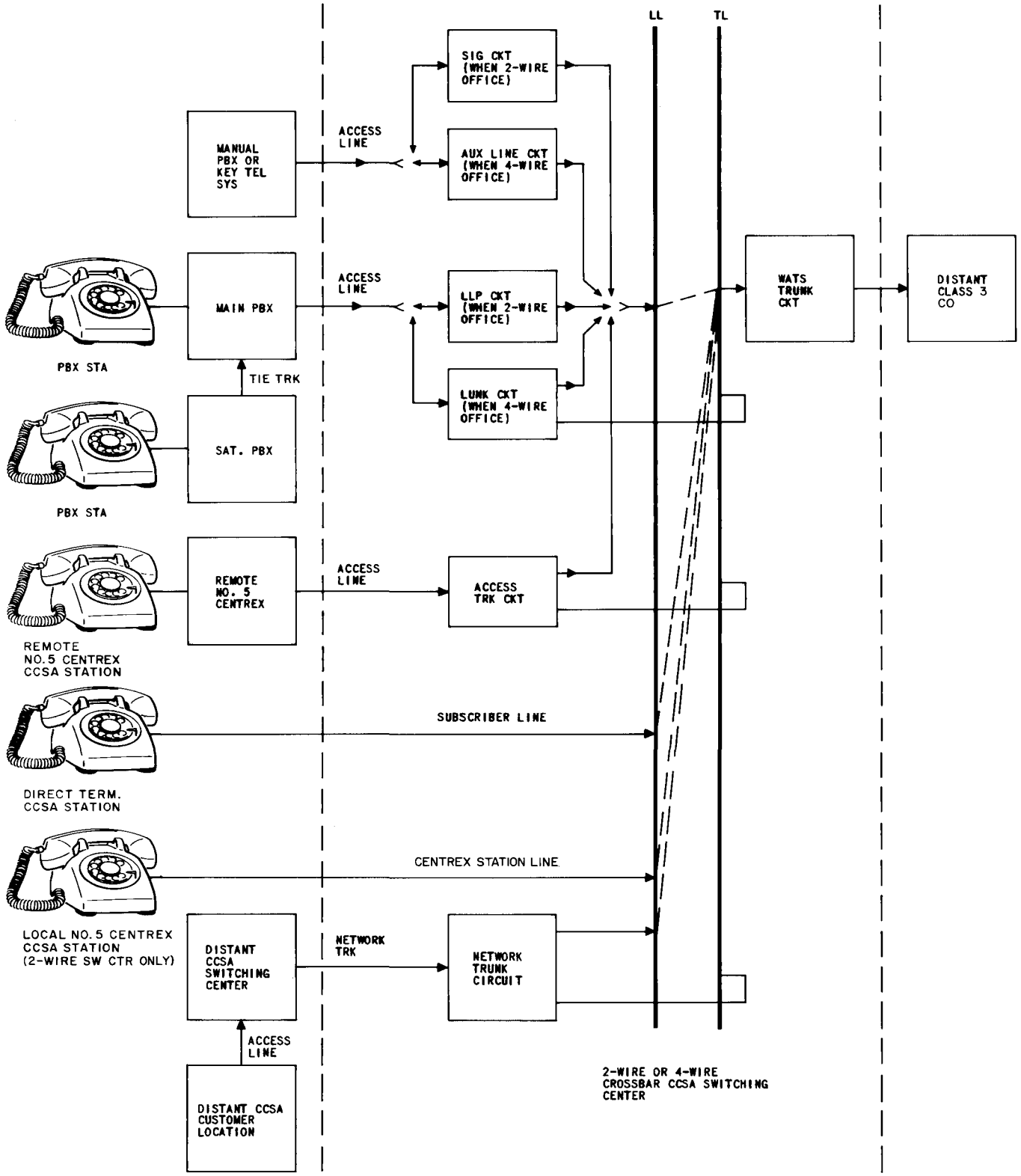

Fig. 19—WATS Call From CCSA Station Via 2-Wire or 4-Wire No. 5 Crossbar Switching Center