U S WEST Communications, Inc. Technical Publication

Compatibility Information For 800 Service Switched Access

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Communications, Inc.
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1. Introduction

1.1 General

This publication describes the interface to the 800 Service to be offered by U S WEST to Carriers. The description includes the signals, conditions, and events that occur at the Point Of Interface (POI) between U S WEST and the Carrier. The term Carrier is used to denote an 800 Service subscriber interfacing a local access and transport area (LATA) network. The interfaces described follow the definition of Equal Access North American Signaling for offices designated and equipped as Equal Access offices and Traditional North American Signaling for non-conforming offices.

A Carrier desiring to serve a LATA must establish one or more Points Of Presence (POP's) within the LATA for connection of its facilities with those of U S WEST.

U S WEST will provide facilities from its intraLATA network to the Carrier's POP, and within the POP to a POI. The POI is the physical point where the LATA access service terminates and the division of responsibility occurs.

This publication is a technical description of the various 800 Service arrangements and does not attempt to define the applicable tariff(s).

1.2 Objectives

The first objective of this publication is to describe interfaces to the 800 Service by defining the signals, conditions, and events that occur at the POI between U S WEST and the Carrier. A quantitative description of the electrical interactions at the POI that will achieve compatible operation is presented. Compatible operation is defined as operation without deterministic error. Error free operation is not necessarily assured.

The second objective of this publication is to promote uniformity of the U S WEST Carrier interface arrangements. E&M lead and loop reverse-battery supervisory signaling methods are described. Omission from this publication does not mean that other specific arrangements are not available in a particular location. Interface arrangements not covered may be available through direct negotiation with U S WEST.

1.3 Alternative Arrangements

This publication characterizes the U S WEST/Carrier interface as completely as possible. However, characteristics of equipment utilized by U S WEST to provide service in some locations may differ from the characteristics described. Also, the facilities described may not be available in all locations. If cases arise that have not been addressed in this document, U S WEST, the equipment manufacturer-supplier and the Carrier will cooperate to resolve any resultant problems.

1.4 Conventions

Unless specifically stated otherwise, the electrical and timing specifications apply at the POI. The formal criteria are distinguished according to the side of the POI to which they pertain. The criteria pertaining to the U S WEST side, identified by the word "will", are statements of the fact based on internal LATA requirements. The criteria about the Carrier side, identified by the word "must", need to be met by the Carrier to ensure its compatibility with the U S WEST network. In addition, the document contains less formal statements about the U S WEST and the Carrier, as well as descriptive information deemed useful to its user. The parameters described may be subject to tariffs, contracts, or regulatory acts.

Although this publication is intended to be implementation free as possible, that is without regard to the particular equipment utilized, standards of service as well as features and functions evolve with technology. Hence, whenever deemed useful to the reader, the material is presented with reference to the existing technology and existing services.

1.5 Content

This section introduces some basic concepts used throughout this publication. These concepts are defined below:

- Calling Customer - the customer that requests an end-to-end connection.
- Called Customer - the customer with whom the calling customer desires to establish an end-to-end connection. In general, the called customer is identified by a Service Access Code (SAC) plus 7 digits that the calling customer uses in requesting the connection.
- End-To-End Connection - a communication path between the end-user interfaces corresponding to the calling and called customers. The end-to-end connection can be viewed as consisting of three parts: the originating part, the Carrier part and the terminating part. This publication deals only with the originating and terminating parts of the end-to-end connection and the corresponding parts of the call that have been labeled the originating call and the terminating call.
- Originating Access - the service of establishing a connection between the calling customer and the POI determined by the called customer's choice of a Carrier.
- Terminating Access - the service of establishing a switched access connection between the POI and the called customer via access tandems or end offices.
- Originating Call - a call placed by an end user within the LATA.
- Terminating Call - a call presented by the Carrier to U S WEST at the access tandem or end office for completion.
- 800 Service Telephone Number - a pseudo-telephone number that must be converted to a true network destination address before returning to U S WEST for switched access delivery to the called customer.

1.6 Organization

This publication consists of six sections and an appendix, a glossary and a list of references. Section 1 presents the purpose of the document and gives a brief outline of its contents.

Section 2 provides a description of 800 Service switched LATA access service from the point of view of the Carrier subscribing to the service.

Section 3 describes the sequences of signals and responses traversing the U S WEST Carrier interface for the types of calls expected to be encountered. The signals that are exchanged serve to establish a connection and provide the billing information for the call.

Section 4 covers the analog methods of supervisory signaling across a single channel interface. Included are types I, II and III, E&M lead signaling methods and loop reverse-battery signaling. The description of each signaling method contains the voltage-current and timing parameters necessary to establish, hold, and release a connection.

Section 5 provides the physical characteristics of the digital time-division multiplexed signal. It comprises the DS-1 (1.544 Mb/s) signal specifications and frame organization.

Section 6 provides lists of various interface configurations for the 800 Service offerings based on information presented in the preceding sections.

2. 800 Service

2.1 General Description

800 Service access provides interconnection for all Carriers to the U S WEST network for their provision of InWATS and MTS/InWATS-type services. This service provides trunk side access to designated 800 Service offices within the U S WEST network. 800 Service, as described in this document, is an originating access service. Terminating 800 Service traffic may be delivered in any manner selected by the Carrier, i.e; Feature Group A, B, C (AT&T temporary service), or D.

800 Service will initially be implemented via the "NXX" or "6 Digit" Plan. The NXX Plan will be temporary in nature and replaced by the U S WEST Common Channel Signaling (CCS) network in late 1988. Two types of trunk signaling will be used for this "interim" plan: (1) Equal Access North American Signaling and (2) Traditional North American Signaling.

800 Service via the U S WEST CCS Network will be offered by both Equal Access signaling and Signaling System 7 (SS-7) interface trunk signaling. This section will be updated as necessary when full SS-7 interface information becomes available.

2.2 NXX Plan Access

U S WEST will designate 800 Service offices within the various LATA's. The criteria for selecting these offices will depend upon several factors which include, but may not be limited to:

- the ability of the office to perform six-digit translation.
- conformance with the Service Switching Point (SSP) locations identified for the CCS Network.
- Carrier trunking (i.e., existing FG-D end-office trunking).
- necessity to lease six-digit translation capability from AT&T OSO's (Originating Screening Office).

2.3 CCS Network Access (Future)

Each LATA will have at least one Service Switching Point (SSP) that will serve as the egress point for 800 Service traffic. The CCS Network requires that all originating traffic be routed to an SSP prior to delivery to a Carrier. When planning for the "interim" NXX Plan 800 Service, it will be beneficial for both U S WEST and the Carrier to arrange 800 Service POP's and POI's to be consistent with the CCS Network Plan to avoid extensive re-arrangements at conversion time.

The CCS/800 Service access points will generally be Access Tandems. This will create the option of combining 800 Service trunking with Equal Access trunking or establishing separate trunk groups at the Carriers option.

2.4 Local Network And End Office Switching

2.4.1 General Description

The U S WEST network for 800 Service access is based on a two-level hierarchy. The first level is the end office level, to which end-user lines are connected. The second level is the access tandem level, where tandem switching systems can be used to concentrate traffic at the access tandem location and distribute it among the Carriers serving the LATA. The switching system serving as an access tandem may also perform other switching functions (including end office and IntraLATA tandem), but the transmission, signaling, and operational characteristics required for the access tandem function are unique to that function. Additionally, the access tandem may be equipped with the Service Switching Point (SSP) feature where the access tandem serves as the CCS Network access point.

For the interim "NXX Plan" 800 Service, access may be provided via an access tandem, an equal access equipped end office (direct trunking), or via leased capacity on AT&T Originating Screening Offices (OSO's). For the interim "NXX Plan" it is recommended that access to the U S WEST network be established through a POP/POI that is consistent with the CCS Network Plan. This will minimize the extent and amount of trunking re-arrangement that will be required to convert to the CCS Network.

2.5 Originating Features

2.5.1 Dialing Plan

An end user placing a call via a Carrier over an 800 Service access arrangement will dial the following sequence:

1 + 800 + NXX-XXXX,

where

- The "1" indicates that a "1" is required. The "1" is a prefix required on direct-dialed calls.
- The "800" is the SAC.
- "NXX-XXXX" is pseudo number assigned to the called party.

These digits are dialed in a continuous sequence, without the need to wait for a second dial tone.

Such calls can be placed with the use of either dial pulse or dual tone multi-frequency (DTMF) address signaling.

2.5.2 800 Access Code

Service Access codes such as "800" are used in place of area codes to designate a particular type of special switched service. The 10XXX Carrier access code must not be used with the 800 access code. The Carrier selection is based upon the dialed 800-NXX code. Based on the needs of each Carrier, the U S WEST network will be able to provide special treatment on calls to such codes. On an 800-NXX basis, such calls may be blocked, routed on a separate trunk group, or included with other direct-dialed calls. Automatic number identification (ANI) is available to a Carrier on calls originating from equal access equipped offices. Traffic from all other offices will be identified only by the originating NPA.

2.5.3 Routing

Traffic originating from equal access equipped offices will be delivered to the Carrier with the dialed "800-NXX-XXXX" number intact. The ANI information will provide the necessary calling number/originating NPA information. Calls originating form non-conforming end offices, via access tandems or OSO's that serve more than one NPA, will be delivered to the Carrier with the "800" code converted to a "00Y-NXX-XXXX" format where:

- "00" indicates that "800" was dialed,
- "Y" identifies the originating NPA.

As an alternative, a separate trunk group could be provided for each originating NPA, from the access tandem to the Carrier. In this case, the "800-NXX-XXXX" would be delivered intact.

In summary, traffic can be delivered to the Carrier in three different formats:

- equal access signaling with or without ANI
- combined traffic with encoded originating NPA information via Traditional North American Signaling.
- separate trunk groups with Traditional North American Signaling on a per NPA basis.

2.5.4 Directory Assistance (To be published at a later date)

2.5.5 Recording

Automatic Message Accounting (AMA) records will be generated for all 800 Service calls. U S WEST will generate Carrier access bills from these records.

2.6 Automatic Number Identification

2.6.1 Equal Access North American Signaling

At the option of the Carrier, ANI can be forwarded along with the called party address on all calls originating from equal access equipped offices. ANI consists of two information digits followed by the area code and the billing number. If the originating party cannot be identified (for example, multi-party lines) only the 3 digit area code is sent.

Information digits are assigned as shown in Chapter 3, Table 3 (5 of 5).

2.6.2 Traditional North American Signaling

ANI is not available with Traditional North American Signaling.

2.6.3 Pre-subscription

Pre-subscription is not applicable to 800 Service. All calls are routed based on the 800-NXX dialed.

2.6.4 Overflow Routing Among POI's

A Carrier may be provided with overflow routing of originating calls between POI's of a LATA.

2.6.5 Network Management

In order to detect and control network congestion resulting from excessive Carrier traffic, U S WEST will collect Carrier related traffic data and, if necessary, use network management controls on Carrier traffic.

2.6.6 Public Stations

Access to Carriers from public telephones will be provided at no charge to the calling customer. Access will be gained by dialing 1+800-NXX-XXXX. If the Carrier has requested ANI (Equal Access North American Signaling only), the information digits of the ANI will identify to the Carrier that the calling station is a public telephone.

2.6.7 Terminating Features

Trunk Side Terminations

- Call Screening

- The Carrier will provide a 7 or 10-digit directory number to U S WEST for each call.

- Calls directed by Carriers to office codes not served by the end office or tandem office to which the call has been presented will be routed to a reorder tone or a vacant code announcement.

- Supervisory Signals

- On terminating calls (from the Carrier's POP/POI to the called customers telephone exchange service location), U S WEST will provide answer and disconnect supervision to the Carrier.

- Address Signaling

- Wink-start start-pulsing signals are provided by U S WEST to the Carrier. Multi-frequency (MF) address signaling is expected from the Carrier.

- Call Progress Tones

- The following standard tones are provided, as appropriate, to the Carrier attempting to complete a terminating 800 Service call:

  Audible Ringing

  Line Busy

  Reorder

- Test Lines

- Access to balance (100 type) test line, milliwatt (102 type) test line, nonsynchronous or synchronous test line, automatic transmission measuring (105 type) test line, data transmission (107 type) test line, loop around test line, short circuit test line, open circuit test line and other test lines may be provided where equipment is available.

- Recording

- 800 Service is traditionally billed to the called customer. The called customer has a high chance of being located in and served from a different Company or Region. Therefore, U S WEST will not be able to provide billing services from the originating AMA records.

- U S WEST will offer terminating recording on an optional basis, subject to the appropriate tariff, for 800 Customers (i.e., the called number). Recording of terminating traffic requires the use of a dedicated access line (DAL). (If a DAL is not used, ALL terminating traffic to the line is recorded, resulting in erroneous billing for the 800 Service.)

- Network Management

- In order to detect and control network congestion resulting from excessive Carrier traffic, U S WEST will collect Carrier related traffic data and use network management controls on Carrier traffic. U S WEST may provide network management capabilities to the Carrier.

2.7 Access Connection

2.7.1 General Description

Transmission channels between Carrier and U S WEST networks terminate at a POI at the Carriers location. The Carrier will have an option to request the type of transmission and supervisory signaling to be used.

Direct access (for the interim "NXX Plan" only) to an equal access equipped end office may, at the option of the Carrier, be equipped with either a 2- or 4-wire interface. Access to an end office via an access tandem / OSO / SSP is available only with a 4-wire interface. Signaling methods will include loop reverse-battery, E&M lead, and robbed bit digital signaling. In addition, multiplexed high capacity interfaces are available. A multiplexed digital interface designated DS-1 (1.544M/bs) is described in Chapter 5.

Address signaling at the interface between U S WEST and the Carrier will use MF signaling and wink-start supervisory protocols. The Equal Access North American Signaling format was designed to provide all the necessary information in a way which requires minimum call setup time. Some of the unique elements of this format are:

- optional provision of 10-digit ANI information ahead of the called party address
- an acknowledgment wink from the Carrier to signify receipt of all digits
- answer supervision returned to U S WEST on all completed calls, whether or not ANI was provided.

The Carrier is required to provide answer supervision to U S WEST. When the called party answers on a call from a Carrier terminating via trunk side connection into U S WEST, U S WEST will return answer supervision to the Carrier.

2.8 Supplemental Feature

The data transmission parameters supplement provides for trouble testing of selected parameters which are normally associated with voice band data transmission performance (e.g., signal-to-C-notched noise ratio, envelope delay distortion, impulse noise counts, intermodulation distortion, phase jitter, and frequency shift).

2.9 End User Connection

2.9.1 General Description

Connection is normally provided to an end user via end office. Historically, 800 Service has been provided over dedicated access lines (DAL's), equipped for terminating AMA recording. The customer billing was derived from the terminating AMA records.

With the introduction of the interim "NXX Plan" 800 Service and continuing with the CCS/800 Service plan, U S WEST will no longer be able to determine that a call delivered by the Carrier for termination to a U S WEST customer is an 800 Service call unless the Carrier makes special arrangements with U S West. The "special arrangements" will consist of one or more of the following items:

- advanced notice to U S WEST of the terminating network address (NPA-NXX-XXXX) to which 800 Service Calls will be delivered.
- service request to U S WEST for installation of a DAL.
- service request to U S WEST for installation of terminating AMA recording capabilities.

The DAL is normally an end office line side connection to the end user. U S WEST can optionally provide trunk side service to the (typically large) end user. Additionally, Directory Number Identification Service (DNIS) and other optional services can be provided.

U S WEST will provide DAL's and /or terminating recording services on an optional basis, if requested by the Carrier.

3. Interface Protocol

3.1 General

The signals associated with the establishment, or release of a connection passing through the point of interface (POI) are:

- seizure
- answer
- disconnect
- winks
- multi-frequency (MF) pulses
- reverse make busy

The set of rules that govern the sequence of these signals and their separation in time is a call protocol. Since there are a number of call types, there are several call protocols. These call protocols are discussed in this section. Chapter 4 will discuss the electrical voltages and currents at the POI used to convey (denote) the signals identified above.

3.2 POI Location

In general, the Carrier's switching system will be connected to a U S WEST access tandem through a trunk. The POI will be somewhere in this trunk. If the Carrier's point of presence (POP) contains a switching system, the POI is likely to be close to the Carrier's switching system. However, the POI may be anywhere within the local access and transport area (LATA) along the trunk. The sequences of signals and responses that occur on these trunks at the POI in establishing and releasing a connection are the call protocols. This section provides the protocol for 800 Service.

A call is the interaction at one POI associated with one end-to end connection. There will usually be two calls - an originating call and a terminating call - in each end-to-end connection. Although these two calls are related from the end-user's point of view, they are described and handled as independent entities. It is important to note that the protocols are described in terms of calls rather than trunks. This form is used because an individual trunk may carry a number of call classes, each of which have different protocols. (Note: See restrictions in the Subsection entitled "Call Protocols"; under "Distinguishing Characteristics").

3.3 Directionality

A basic characteristic of trunks is their directionality; i.e., the direction in which supervisory and address signals may be applied. In this context trunks are 1-way outgoing, 1-way incoming, or 2-way. To clarify the terminology, a 1-way outgoing trunk from U S WEST (1-way incoming to the Carrier) is a trunk carrying originating calls. A 1-way incoming trunk to U S WEST (1-way outgoing to the Carrier) carries terminating calls. Two-way trunks can carry both originating and terminating calls.

3.4 Signaling Sequences

The following signaling sequences will be discussed in this section:

- equal access North American signaling
- traditional North American signaling
- terminating

3.5 Equal Access North American Signaling

Equal access North American signaling is characterized by a pulsing stream that consists of two pulsing sequences. The sequence which is transmitted first contains the calling customer's identification number which is used for billing purposes. This sequence is referred to as the identification sequence. The second pulsing sequence contains the called telephone number. This sequence is referred to as the address sequence. This arrangement allows the identification sequence (the ANI digits) to be pulsed to the Carrier before the called number. With the addition of overlap pulsing, which permits the initiation of pulsing to the Carrier before the customer has completed dialing, the call set up time is minimized. The nominal originating call sequence is as follows:

- After receipt from the customer of all but the last four digits of the called number, the U S WEST switch will initiate actions to seize a trunk to the Carrier.
- The Carrier must respond to the trunk seizure with a wink when ready to receive pulsing (Wink signals are described in Appendix A, Section 1).
- Upon receipt of the wink from the Carrier, the U S WEST switch will start outpulsing the identification sequence. MF pulsing as described in Appendix A, Section 2 will be used. The identification sequence will be in the format:

  KP + II + 7/10 Digit ANI + ST

- When the customer completes dialing and upon completion of outpulsing of the identification sequence, the U S WEST switch will outpulse the address sequence. The address sequence will be in the format:

  KP + 800 + NXX + XXXX + ST

- When the Carrier has received all the pulsing information, it must respond with a second wink signal, called an acknowledgment wink.
- After outpulsing or upon receipt of the acknowledgment wink, the U S WEST switch connects the talking path from the calling customer to the Carrier.
- When the called customer answers, the answer off-hook signal must be sent from the Carrier to the originating U S WEST office.
- When the call is over, the disconnect sequence described in Appendix A, Section 6 is initiated.

3.6 Traditional North American Signaling

Traditional North American Signaling is characterized by a pulsing stream that consists of only one pulsing sequence. ANI cannot be provided with Traditional North American Signaling. The nominal originating call sequence is as follows:

- After receipt from the customer of 1 + 800 + NXX + XXXX, U S WEST will start actions to seize a trunk to the Carrier.
- The Carrier must respond with a start-wink signal.
- Upon receipt of the start-wink signal, U S WEST will MF pulse the address sequence (KP + digits + ST) where "digits" will consist of the actual number dialed (less the access digit "1") in the format:

  KP + 800 + NXX + XXXX + ST,

  or, when the trunk group to the Carrier is serving calls from more than one originating NPA, the "800" SAC will be converted to the form:

  KP + OOY + NXX + XXXX + ST,

  where the "Y" is a unique, locally assigned digit used to identify the originating NPA.
- The Carrier must respond with a steady off-hook signal.
- Called customer answer supervision must be returned through the Carrier network to U S WEST. Failure to return answer supervision may activate toll fraud features in the U S WEST switch, causing a disconnect sequence to be activated.
- When either the customer or the Carrier (because of distant party disconnect) decides it is finished with the connection, the disconnect sequence described in Appendix A, Section 6 is initiated.

3.7 Terminating

- The terminating call sequence is as follows:

- The Carrier will seize a trunk to U S WEST and apply an off-hook signal to the trunk.
- U S WEST will respond with a standard wink signal which signals the Carrier that the U S WEST switch is ready to receive the address pulsing sequence.
- Upon receipt of this wink-start signal from U S WEST, the Carrier must MF out pulse the address sequence.
- U S WEST will screen and route this address sequence and deliver the call to the proper station in the LATA.

- When the called (800 Service) customer answers, answer supervision (off-hook) will be passed to the Carrier from U S WEST.
- When the call is over, the disconnect sequence described in Appendix I, Section 6 will be initiated.

3.8 Carrier Classification

The call protocols described above assume that the Carrier(s) will be classified as InterLATA Carriers, i.e., Carriers providing connections between LATA's and serving areas where the calling and called customers are in World Zone 1.

3.9 Trunk Groups

3.9.1 Equal Access North American Signaling

To provide the Interim "NXX Plan" 800 Service, U S WEST will establish a trunk group or groups for the Carrier at the 800 Service access tandem or end office location. As noted in Chapter 2, Section 4, it is recommended that the Interim "NXX Plan" 800 Service trunking arrangements for access to the U S WEST network be established through POP(s) POI(s) in a manner that is consistent with the CCS Network plan. Trunk groups may be dedicated to 800 Service or, where switching system technology permits, combined with other switched access.

3.10 Traditional North American Signaling

To provide the Interim "NXX Plan" 800 Service, U S WEST will establish a trunk group or groups for the Carrier at the 800 Service access tandem or leased OSO switch locations. Only 800 Service calls will be directed to the Carrier over these trunks. Access tandems serving more than one originating NPA will deliver all originating 800 Service traffic on one trunk group with the originating NPA encoded in a "OOY" format as described in the Subsection entitlede "Traditional North American Signaling". Optionally, the Carrier may choose to have a separate trunk group for each originating NPA.

3.11 Call Classification

There are a number of variables that characterize an 800 Service call protocol. The following assumptions are made:

- Direction (originating or terminating)
- Carrier = interLATA
- Destination = intraLATA, interLATA within World Zone 1.
- Signaling sequence:
  - equal access North American signaling
  - traditional North American signaling

- Type = Service Access Code

These variables determine four unique call protocols - two originating and two terminating.

3.12 Call Protocols

3.12.1 Direct Dialed Originating 800 Service Calls

- These are direct dialed calls destined for completion within World Zone 1.
- Distinguishing Characteristics (EA North American Signaling)
- The generalized call origination information is as follows:

  Customer dials 1+800+NXX+XXXX

  Outpulsing Sequence

  Identification KP+(II+ANI)+ST

  Address +KP+800+NXX+XXXX+ST

- The call will appear on an equal access signaling trunk group.
- In the identification sequence, the first digit after KP is never 1.
- The ST pulse at the end of the identification sequence is not primed.
- The number of digits in the address sequence (other than KP and ST) is either 7 or 10 as determined by U S WEST.
- The first digit in the address sequence after KP is never 0.
- Distinguishing Characteristics (Traditional North American Signaling)

  Customer dials 1+800+NXX+XXXX

  Outpulsing Sequence KP+800+NXX+XXXX+ST

  (or) KP+00Y+NXX+XXXX+ST

- There is no identification sequence.
- The number of digits in the outpulsing sequence (other than KP and ST) is 10.
- The call will appear on a trunk group per originating NPA with the outpulsed number unchanged from the customer dialed number, or, optionally on a trunk group carrying calls from more than one originating NPA with the dialed "800" converted to "00Y" where the "Y" identifies the originating NPA (The "Y" is a locally assigned value).
- It may be technically feasible from certain vendor switches to combine EA North American Signaling and Traditional North American Signaling on the same trunk group. U S WEST will optionally provide this service where switch compatibilities allow.

- Specific Call Examples

A specific example of an 800 Service call using Equal Access North American Signaling is shown in Figure 3-1. A specific example of the same call using Traditional North American Signaling is shown in Figure 3-2.

3.13 Signaling Timing Intervals

3.13.1 Equal Access North American Signaling

When the Carrier is ready to receive the initial outpulsing from U S WEST, it must return a standard wink-start signal to U S WEST. The end of the wink signal must not occur until 210 ms after the trunk seizure off-hook signal is received at the Carrier switch. The Carrier must complete the wink-start signal within 3.5 s from the time of seizure of the trunk.

After receiving the wink-start signal, U S WEST will send the identification sequence to the Carrier. The start of outpulsing will be delayed as little as possible, but not less than 50ms. This sequence (as noted earlier) may be sent before dialing is completed. As soon as dialing is completed, the address (called number) sequence is sent from U S WEST to the Carrier. Because the U S WEST office waits until dialing is completed before sending the address sequence, there can be a time delay between the identification and address sequences. When the Carrier has received the complete address sequence, it must respond with the acknowledgment wink signal within 3.5 s of the completion of outpulsing. The transmission of this wink signal must be delayed at least 200 ms after receiving the address sequence. In order for U S WEST to differentiate unequivocally a received wink signal, the Carrier must provide an on-hook state between these two signals of at least 250 ms duration. If the Carrier does not return start winks and acknowledgment winks within the times specified above, U S WEST may route the call to an announcement.

If an invalid code is received by the Carrier, the Carrier should return an invalid or vacant code announcement to U S WEST. The start of an announcement sent by the Carrier should be delayed 1.2 s after transmittal of the acknowledgment wink in order to ensure the entire announcement is passed to the calling customer.

On 1-way trunks, if the Carrier returns an off-hook longer than 350 ms instead of a wink, U S WEST will release the connection to the Carrier and return an announcement to the customer.

If a trunk from U S WEST to the Carrier cannot be seized (because all trunks to the Carrier are busy), U S WEST will return a user-oriented no circuit (NC) announcement to the calling party.

3.13.2 Alternative Arrangements

There are alternative arrangements available to Carriers. These arrangements, which must be negotiated with U S WEST, are described below.

- Non-Overlap Outpulsing

- With non-overlap outpulsing, all dialed digits must be received by the U S WEST end office before any outpulsing takes place. After all dialed digits are received, the U S WEST office seizes a trunk toward the Carrier. Then, after receiving a wink-start, the full pulsing stream is outpulsed from U S WEST. The basic format of the pulsing stream is as follows:

  KP+II+ANI+ST+KP+800+NXX+XXXX+ST

- This pulsing stream will be received as (approximately) one continuous sequence. However, there will be a small time delay between the identification and address sequences. This delay will be at least as long as the MF pulsing inter-digital interval (See Appendix A, Subsection 2.)

- No ANI

- The Carrier has the option to elect to receive ANI or not. Without ANI, the basic format of the pulsing stream received at the Carrier will be as follows:

  KP+ST+KP+800+NXX+XXXX+ST

- It will be noted that the identification sequence without ANI has been reduced to KP+ST. With the elimination of ANI, the two information (II) have also been eliminated.

3.14 Traditional North American Signaling

3.14.1 Start Wink

The Carrier must return the start-wink signal within 4 seconds of the trunk seizure.

The end of the start wink must not occur until 210 ms after receipt of the incoming seizure signal. The Carrier must be prepared to receive MF pulses 35 ms after the end of the start wink.

If off-hook from the Carrier is not received within 4 seconds after completion of outpulsing the information sequence, the trunk to the Carrier may be restored to on-hook and an announcement returned to the originating customer. The basic format of the pulsing stream is as follows:

KP+800+NXX+XXXX+ST

3.15 Alternative Arrangements

The Traditional North American Signaling is a fixed format. ANI is not available. In lieu of ANI, the "800" may (optionally) be converted to a "OOY" format in which the "Y" indicates the originating NPA. The basic format of the pulsing stream is an follows:

KP+00Y+NXX+XXXX+ST

The "00Y" format is convenient for receiving traffic from Access Tandem switches that serve more than one originating NPA. Another alternative for identifying the originating NPA is the use of dedicated trunk groups.

3.15 Common Channel Signaling (Future arrangement)

3.16 Terminating

3.16.1 Terminating Calls

These are calls incoming to the LATA where it is desired to complete a connection to the 800 Service called party. These are calls to valid telephone numbers for 800 Service customers served by LATA end offices sub-tending the Carrier POI that presents the call to U S WEST. The Carrier cannot return the dialed "800-NXX-XXXX" to the U S WEST without first converting that dialed number into a valid terminating number. Calls presented to U S WEST in the format of 800-NXX-XXXX by the Carrier will be routed to an appropriate invalid code or vacant code recording.

The Carrier will be requested to provide either a 7-digit or 10-digit address as required by the U S WEST offices.

3.16.2 Maximum Time Intervals

U S WEST will return the wink-start signal to the Carrier within 8 seconds from the time of seizure of the trunk.

The Carrier must send the address pulsing sequence to U S WEST within 3.5 seconds from the receipt of the start-wink signal.

If no terminating address characters are received within 5 seconds of a Carrier applied seizure (off-hook) signal on the trunk from the Carrier to U S WEST, the trunk may be considered to have a "permanent signal" and may be accorded maintenance treatment.

If U S WEST does not receive all of the called party destination code within 20 seconds after the start signal, the trunk may time out and initiate partial dial treatment. A partial dial condition on a trunk will be treated in the same manner as permanent signal condition.

Table 3 Originating Call Protocols (1 of 5)

Call Type	Carrier	Destination	Signaling Sequence	Call Protocol
Service Access Code	IC	World Zone 1	EA North American	1
Service Access Code	IC	World Zone 1	Traditional North American	2

Table 3 Terminating Call Protocols (2 of 5)

Call Type	Carrier	Destination	Signaling Sequence	Call Protocol
Directory Number	IC	Termination within LATA	Wink-Start Operatin	3
Test			with MF Pulsing	4

Table 3 Originating Call Sequences (3 of 5)

Protocol	Customer Dials	Outpulsing Sequence	
1	1 + 800 + NXX + XXXX	Identification KP + (II + ANI) + ST	Address + KP + 800 + NXX + XXXX + ST
2	1 + 800 + NXX + XXXX	NONE (Alternate)	KP + 800 + NXX + XXXX + ST KP + 00Y + NXX + XXXX + ST

Table 3 Terminating Call Sequences (4 of 5)

Protocol	Carrier Outpulses
3	KP + 7/10 DIGITS + ST
4	KP + 95X + XXXX + ST

Table 3 Equal Access Signaling Information (II) Digit Assignments (5 of 5)

Information Digits	Explanation
00	Identified Line — No Special Treatment
01	ONI (Multiparty)
02	ANI Failure
06	Hotel/Motel
07	Coinless, Hospital, Inmate, etc.
08	InterLATA Restriction
10	Test Call
12 - 19	Not to be Assigned due to conflicts with 1NX
20	AIOD — Listed Number Sent
27	Coin
68	InterLATA Restricted — Hotel/Motel
78	InterLATA Restricted — Coinless, etc.
95	Test Call

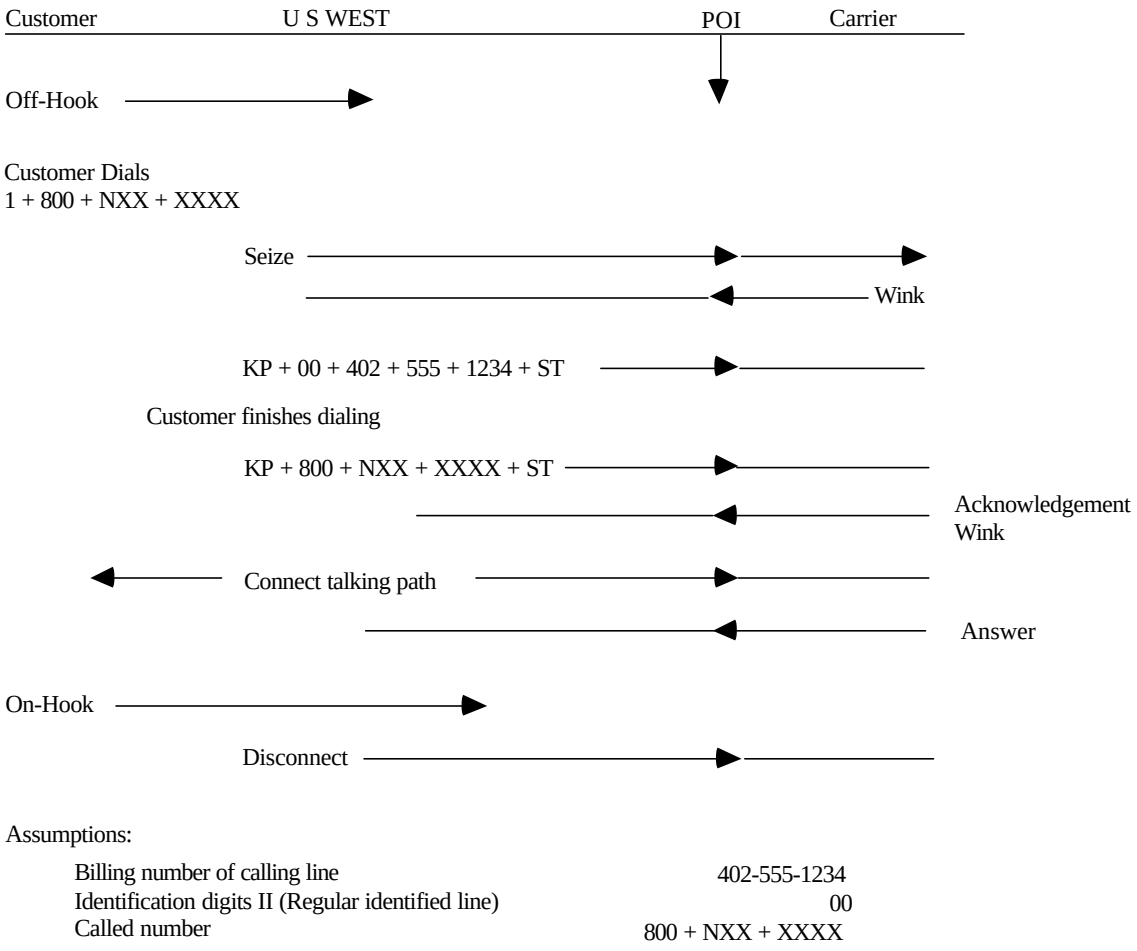
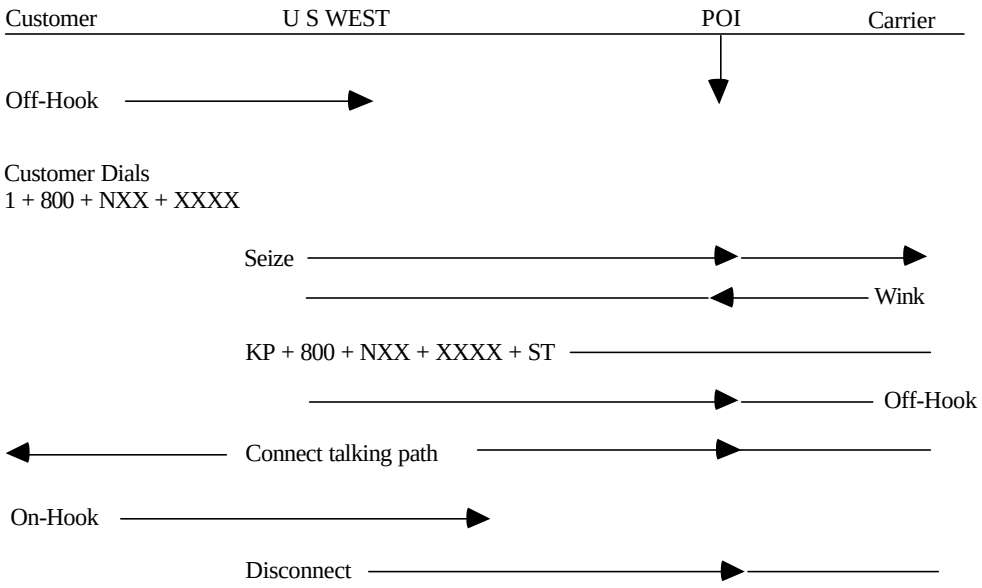


Figure 3-1 Example of 800 Service Call Using Equal Access North American Signaling



Assumptions:

Dialed number is passed to Carrier without conversion of digits "800" to 00Y for originating NPA identification

Figure 3-2 Example of 800 Service Call Using Equal Access North American Signaling

4. Physical Characteristics Single Channel Interface

4.1 General

4.1.1 Interface Signals

The information that is exchanged across the point of interface (POI) for establishing and disconnecting switched connections was described in Chapter 3. The following signals are used in those descriptions:

- Seizure
- Answer
- Disconnect
- Winks
- Multifrequency (MF) Signals
- Reverse make busy

These signals are defined as follows:

- Seizure

- A seizure signal is the application of off-hook at the outgoing end of a previously idle trunk. A condition called glare arises when both U S WEST and the Carrier apply signals simultaneously at their ends of a 2-way trunk. Glare is described in Appendix A, Section 3.

- Answer

- Answer is the off-hook signal from U S WEST to the Carrier indicating the called customer has gone off-hook in response to a terminating call.

- Disconnect

- A disconnect signal is an off-hook signal which occurs after an off-hook state and persists beyond a prescribed limit and may last indefinitely. The description of disconnect signals is provided in Appendix A, Section 6.

- Winks

- There are off-hook and on-hook wink signals. An off-hook wink is an off-hook pulse during an on-hook state. An on-hook wink is an on-hook pulse during the off-hook state.

- A start wink is an off-hook wink that is used to respond to a seizure.

- MF Signal

- A MF Signal is a pulse consisting of two of a group of six frequencies. It serves as a control or information signal sent between U S WEST and the Carrier. The description of MF signals is provided in Appendix A, Section 2.

- Reverse make busy

- A reverse make busy signal is an off-hook signal from the Carrier on a U S WEST outgoing trunk. This signal is applied while a trunk is idle, as contrasted to the answer signal on a busy trunk. There is no minimum or maximum length for this signal.

4.1.2 Signal Classification

The signals associated with establishing and disconnecting connections crossing the POI between the Carrier and U S WEST for 800 Service Switched Access service may be classified as follows:

- dc supervisory signals
- timed transition dc signals
- inband ac signals

Characterizing the dc supervisory signals describes the seizure, answer and disconnect signals. The addition of timing restrictions on the transitions between supervisory states covers dial pulse and wink signals. Characterization of the frequency components, the power and time limits on bursts of voice frequency tones describes the inband signals. The remainder of this section consists of a description of the interface voltages and currents for the various forms in which the dc supervisory states of no-hook and off-hook may appear at the POI. This supervisory information is followed by a description of the timing characteristics which give transitions between on-hook and off-hook special significance. The section concludes with a description of the inband signals used to transmit numerical and control characters.

It is, however, appropriate to describe the voice frequency transmission interface before continuing with the description of a signaling method.

4.1.3 Transmission

Transmission specifications at the POI are related to the type of interface (2- or 4-wire) and include transmission level point and impedance.

- Interface Group 1 (2-Wire Voice Frequency)

- U S WEST will provide a nominal transmission level point of -3 dB (-2 to -4 dB for facilities without gain) at the POI and the Carrier must provide a transmission level point of 0 or less dB at the POI. The Carrier must provide a nominal impedance at the POI of 900 ohms in series with 2.16 microfarads.

- Interface Group 2 (4-Wire Voice Frequency)

- When the U S WEST equipment is located on the Carrier premises, both transmit and receive transmission level points at the POI are determined by specification for the interface employed.
- When the U S WEST equipment is not located on the Carrier premises, U S WEST will provide a transmission level point in the range of 0 to -9 dB at the POI, and the Carrier must provide a transmission level point within the range of 0 to +5 dB at the POI. The specific transmission level points will be selected on the basis of the available U S WEST equipment and facilities.
- The Carrier must provide a nominal impedance at the POI of 600 ohms.

4.2 DC Supervisory Signals

4.2.1 Loop Reverse-Battery Signaling

• Operation

- The principle of operation of loop reverse-battery signaling is illustrated in Figures 4-1 and 4-2. It uses loop open (on-hook) and closure (off-hook) signals from the outgoing end and reversals (the first reversal after idle is off-hook, second reversal on-hook, etc.) of battery and ground from the incoming end. The circuit shows that in the idle state, the incoming end applies a voltage source such that the ring conductor is negative with respect to the tip conductor, while the outgoing end keeps the circuit open for dc signals. The outgoing end signals a seizure of the trunk by closing the A contacts. At the incoming end, the resulting flow of dc current causes relay A to operate which in turn causes an MF receiver to be attached. The reversal of contacts RV changes the direction of loop current and causes relay CS to operate.
- Either end (outgoing or incoming) signals a disconnect on an established connection by going to the on-hook state. The trunk is released when both ends are on-hook.

• Application

- Loop reverse-battery signaling is used with 1-way trunking.

• Originating 800 Service Call

- Carrier Network Characteristics

  On-Hook

  • Voltage applied by the Carrier must be -52.5 to -42.75 V dc ring with respect to tip, and the tip conductor must be grounded. The Carrier must provide equal tip and ring resistances not exceeding 450 ohms each.

  Off-Hook

  • The off-hook is the same as the on-hook described above (a.) except that the role of the tip and ring conductors are reversed.

- U S WEST Network Characteristics

  On-Hook

  • The U S WEST network will maintain a resistance of at least 30 kilohms between tip and ring, tip and ground, and ring and ground.

  Off-Hook

  • The U S WEST network will maintain resistance of 3 kilohms or less between tip and ring and resistance of at least 30 kilohms between tip and ground and between ring and ground.

• Terminating Call

- Carrier Network Characteristics

  On-Hook

  • The Carrier will maintain a resistance of at least 30 kilohms between tip and ring, tip and ground, and ring and ground.

  Off-Hook

  • The Carrier will maintaining resistance of 500 ohms or less between tip and ring and resistance of at least 30 kilohms between tip and ground and between ring and ground.

- U S WEST Network Characteristics

  On-Hook

  • Voltage applied by U S WEST will be -52.5 to -42.75 V dc tip with respect to ring, and the tip conductor will be grounded. The tip-to-ring resistance will not exceed 3400 ohms.

  Off-Hook

  • The off-hook is the same as the on-hook described above (a.) except that the roles of the tip and ring conductors are reversed.

• Simplex Signaling

- Where appropriate for transmission reasons, the loop signaling interface may be a physical 4-wire interface with simplexed signaling. The arrangement is shown in Figure 4-3.

4.3 E&M Lead Signaling

- Type I

- Operation

  E&M lead signaling systems derive the name from historical designations of the signaling leads on the circuit drawings covering these systems. Traditionally, the E&M lead signaling interface consists of two leads between the switching (trunk) equipment and the signaling equipment. The E lead Carriers signals from the signaling equipment to the switching (trunk) equipment. The M lead Carriers signals from the switching (trunk) equipment to the signaling equipment. E&M lead signaling uses leads physically separate from the transmission leads. Historically, E&M lead signaling circuits have used only one lead for each direction of transmission with a common ground return. Along with the introduction of electronic switching, balanced circuits have come into use. As a result, the original E&M lead interface is now known as Type I (and the balanced versions as Type II or Type III). Figure 4-4 shows the traditional/historical E&M lead arrangement and the POI. Figure 4-5 shows Type I interface circuitry. Table 4-A shows the states of the E and M leads for the Type I interface and their relations to the U S WEST Carrier supervisory states.

- Application

  E&M lead signaling can be used on both 1-and 2-way trunks. This signaling arrangement will, however, require the placement of U S WEST equipment at the Carrier POP.

Table 4 Type I Interface (1 of 3)

Supervisory state		State of lead	
U.S. West	Carrier	E	M
On-Hook	On-Hook	Battery	Ground
Off-Hook	On-Hook	Ground	Ground
Off-Hook	Off-Hook	Ground	Battery
On-Hook	Off-Hook	Battery	Battery

- Description of the Interface

  M Lead

  - The Carrier must apply local ground to the M lead for the on-hook state and local -48 V battery to the M lead for the off-hook state. It is desirable that the battery feed be through a current limiting devise for fuse and circuit protection purposes. The current limiting device should have a resistance on not over 60 ohms while under a load of 85 mA in the M lead plus any internal Carrier circuit load current. There must not be more than a 5 V drop between the battery supply and the M lead and the device must handle up to 85 mA of continuous M lead current in the off-hook state. In the on-hook state, it is desirable that the potential drop between the M lead and local ground not exceed 1 V while external -50 V is connected to the M lead through 1 kilohm. It is desirable that a surge suppression device be connected from the M lead to local ground. The recommended device is a zener diode, or equivalent, with a breakdown of 65 V (10% tolerance). A functionally satisfactory substitute for the zener diode is a nominal 1 kilohm resistor from M lead to local ground. However, this is not recommended for new circuit designs. The transition state between on-hook and off-hook must be either open or any voltage between ground and -48 V. It is desirable that the transition state be not longer than about 1 ms.

  E Lead

  - On the E lead, the Carrier will receive an open for the on-hook state and a ground for the off-hook state. It must use a sensor referenced to local -48 V so that the voltage will be present on the E lead during the on-hook state. There are no resistance limitations for the sensor, but is desirable that the resistance be low enough that the E lead conductor capacitance will not cause excessive distortion to signaling. Also, it is desirable that E lead current be limited to a maximum of 50 mA. The sensor sensitivity must allow the E lead to be at least 150 ohms but it must not detect a 20 kilohm ground as an off-hook state. If the sensor is inductive, it must not detect a 20 kilohm ground as an off-hook state. If the sensor is inductive, it must be equipped with a surge suppressor that limits voltage rate of change to 1 V/uS and the maximum voltage to 300 V. A 470 ohm resistor in series with about 0.13 uF capacitor is suitable for use across relay windings of 500 ohms or more.

- Type II

- The Type II E&M lead interface employees balanced signaling leads to reduce the noise influence into electronic switching systems. The Type II interface (Figure 4-6) is a 4 wire, fully looped but non-symetrical arrangement.

- Signaling from U S WEST to the Carrier is by means of opens and closures across the E and SG (signal ground) leads for the on-hook and off-hook state signals, respectively. Signaling from the Carrier to U S WEST is by means of opens and closures across the M and SB (signal battery) pair of leads for the on-hook and off-hook state signals, respectively. Table 4-b shows the states of the E and M leads for the Type II interface and their relations to the U S WEST Carrier supervisory states.

Table 4 Type II Interface (2 of 3)

Supervisory state		State of lead	
U.S. West	Carrier	E	M
On-Hook	On-Hook	Battery	No Battery
Off-Hook	On-Hook	Battery	Battery
Off-Hook	Off-Hook	Ground	Battery
On-Hook	Off-Hook	Ground	No Battery

- The contact labeled "P" is Figure 4-6 is held closed to represent the off-hook supervisory state at the end (the Carrier end). A closed contact "P" applies battery to the M lead. Thus, the off-hook supervisory state is represented at the POI by battery on the M lead.
- Contact "P" is held open to represent the on-hook supervisory state. With an open contact "P" there is no battery on the M lead and the M lead shows an open circuit (high impedance to ground). Thus, the on-hook supervisory state is represented at the POI with no battery on the M lead.

• Description of the Interface

- M Lead

  Signaling from the Carrier to U S WEST is over the M and SB leads. The Carrier must apply a dc closure across these leads for the off-hook state and an open for the on-hook state. The closure device must accept a voltage supply of either +12 V nominal or -48 V nominal from the SB lead. There are no current limitations for M lead loads; however, the usual off-hook current is in the range of 1 to 12 mA. The SB lead includes current limiting resistance that will limit the current to the M lead when a fault ground is accidentally applied to the M lead. This is an event that must be considered likely since the M lead is commonly patched into a variety of test sets. The SB lead current limiters present a rather hostile environment for a solid state switch, or even some relay contacts. Three kinds of limiters are in use:

- A fixed resistor is the most widely used limiter, the lower limit being 300 ohms. This limit will allow a worst case fault current of steady 175 mA.
- Another limiter is a resistance lamp. The lamp may have a cold resistance of 12 ohms. A reasonable worst case with the lamp might be a total circuit resistance of 15 ohms and the supply at -52.5 V. The fault current will peak at 3.5 A, dropping to 0.8 A within about 10 ms and stabilizing at about 0.36 A within 50 ms.
- The third limiter is a positive temperature coefficient thermistor with a minimum cold resistance of about 40 ohms. The highest fault current will peak at about 1.7 A in 100 ms, reducing to about 20 percent of that within 0.5 second, and stabilize at about 30 mA after a few minutes. Any series resistance in the fault path will reduce the peak current, delay the time of reaching peak, and delay the decay to the final stable value.
- The M to SB lead switch must meet the following limits in the on-hook state. If the M lead is grounded, the M lead current must not exceed 0.1 MA whether the SB lead is open or connected to -50 V. If +12 or -12 V is connected to the M lead while the SB lead is open, the M lead current must not exceed 0.024mA. In the off-hook state, the potential drop from the M lead to the SB lead must not exceed 2 V. Since there is no lower limited for M lead current, current sensors in the M lead are not recommended for the Carrier. No capacitor type surge suppression device is permitted across the M and SB leads or from the M lead to ground.

- E Lead

  For receiving from U S WEST, the Carrier must detect a closure across the E and SG leads for the off-hook state and an open for the on-hook state. The Carrier must supply local ground to the SG lead and use a sensor on the E lead, The sensor must be biased with -48 V so that voltage will be present on the E lead during the on-hook state. If testing compatibility with common E lead status indicators is not required, it is permissible to allow the E lead voltage to be as low as -20 V during on-hook state signal. It is desirable to use -48 V; however, there are no resistance limits for the E lead sensor, but it is desirable to keep lead currents low (less than 50 mA). The sensor must permit the E and SG leads to be at least 150 ohms each but a 20 kilohm ground on the E lead must not be detected as an off-hook signal. Surge suppression across an inductive sensor is required so that voltage rate of change is limited to 1 V/us and the maximum voltage is 300 V. For example, 470 ohms is series with 0.13 uF is suitable for relays having a resistance of 500 ohms or more.

- Type III Interface

- Operation

  The Type III interface is a 4-wire, partially looped, E&M lead signaling interface. It is essentially the same as the Type I interface except that the battery and ground for signaling on the M lead are supplied by the U S WEST E lead originate signaling equipment. The Carrier always originates on the M lead with this interface. Type III should be used only when the Carrier's termination does not have capability to provide Type I or Type II interface.

Table 4 Type III Interface (3 of 3)

Supervisory state		State of lead	
U.S. West	Carrier	E	M
On-Hook	On-Hook	Battery	Ground
Off-Hook	On-Hook	Battery	Battery
Off-Hook	Off-Hook	Ground	Battery
On-Hook	Off-Hook	Ground	Ground

- Description of the Interface

  Electrical Characteristics

  - The E and M lead electrical characteristics are the same as for the Type II interface (reference C 1 and 2) with the exception that the source of ground for the SG lead is from the signaling equipment.

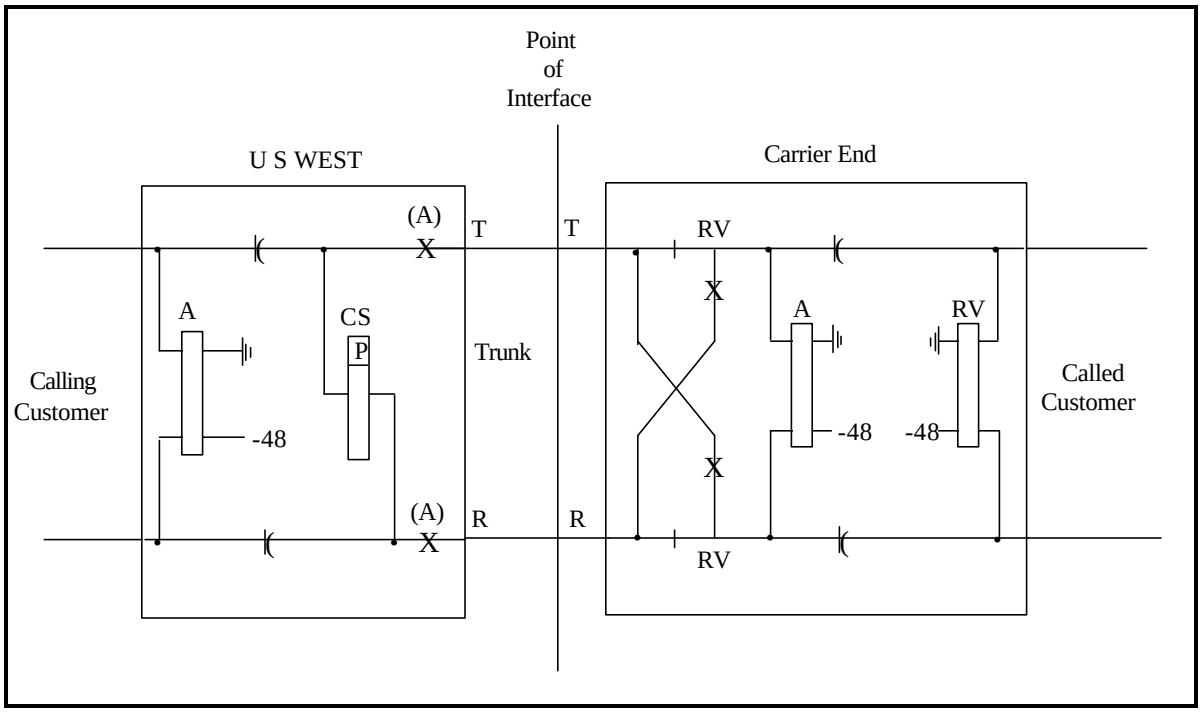


Figure 4-1 Loop Reverse-Battery Signaling-Originating Call

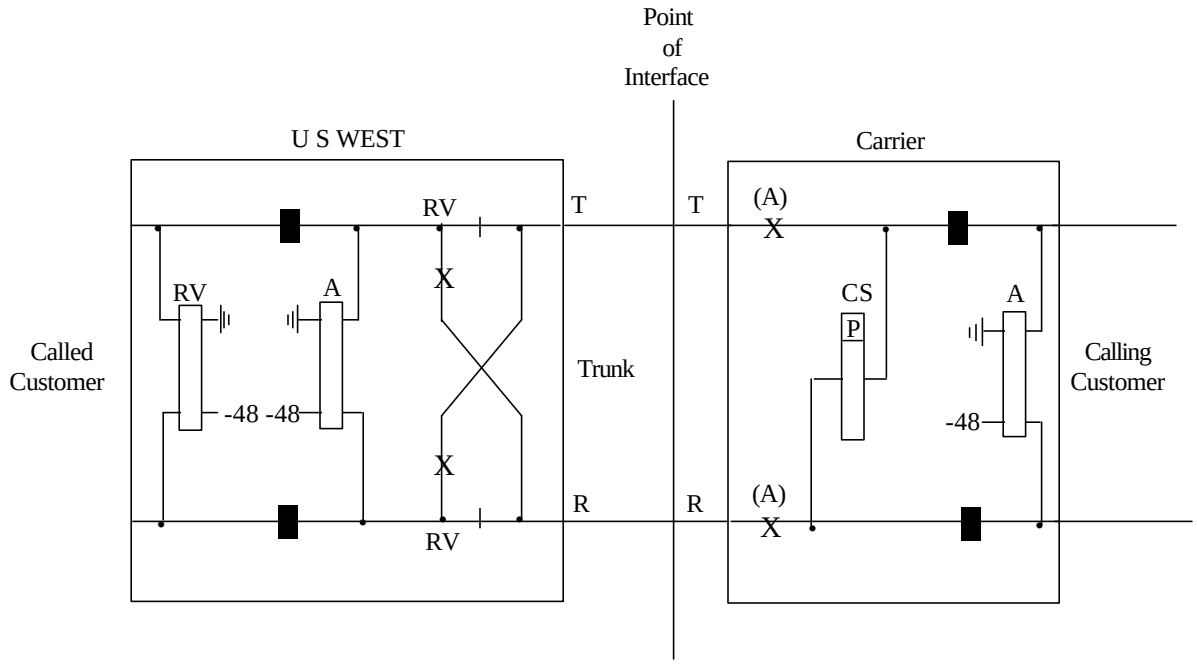


Figure 4-2 Loop Reverse-Battery Signaling-Terminating Call

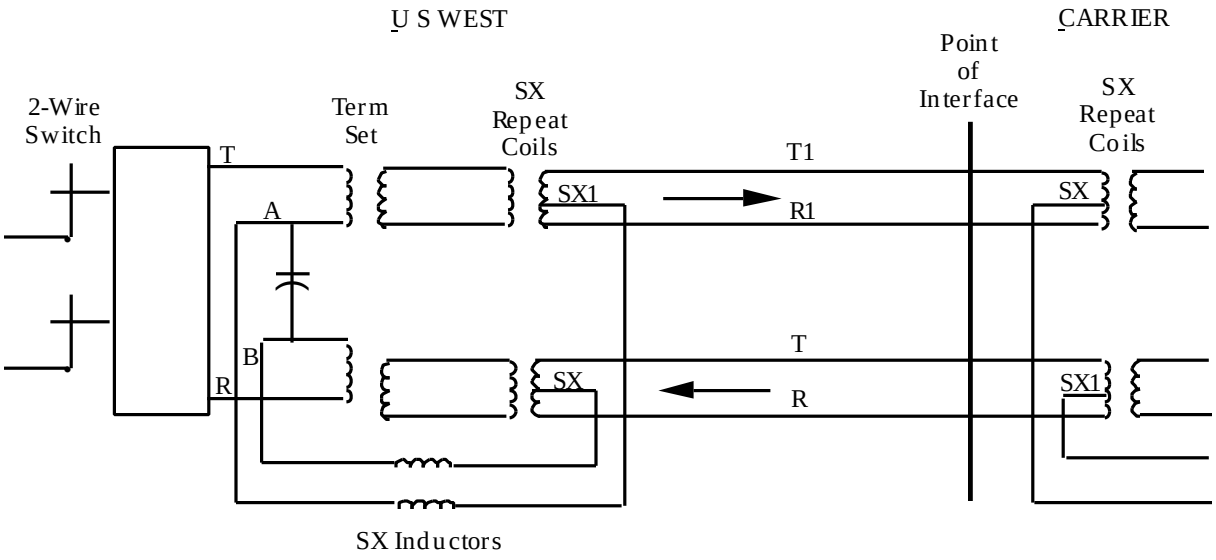


Figure 4-3 Typical 4-Wire Configuration

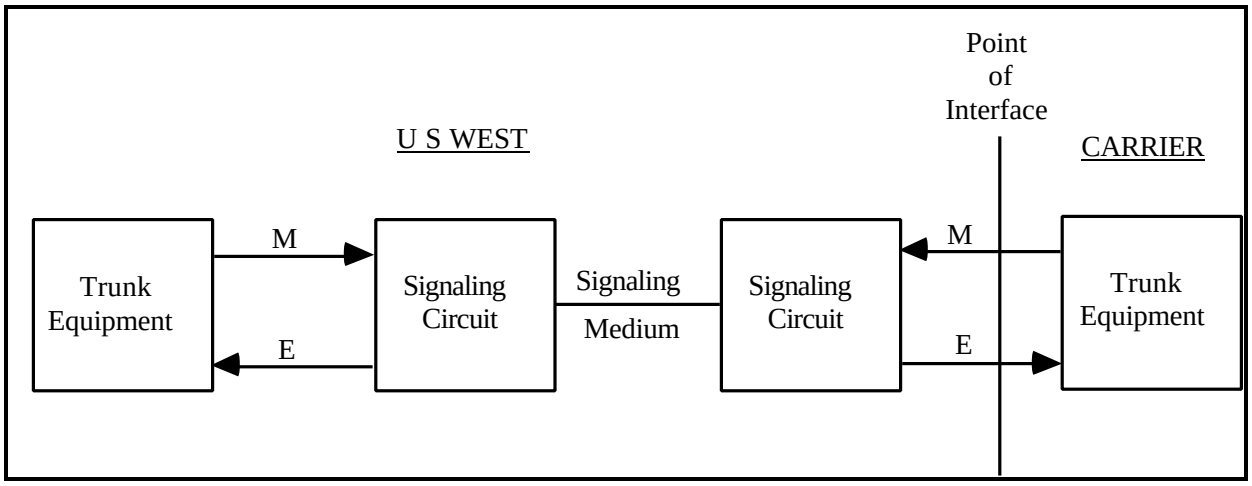


Figure 4-4 E&M Lead Signaling

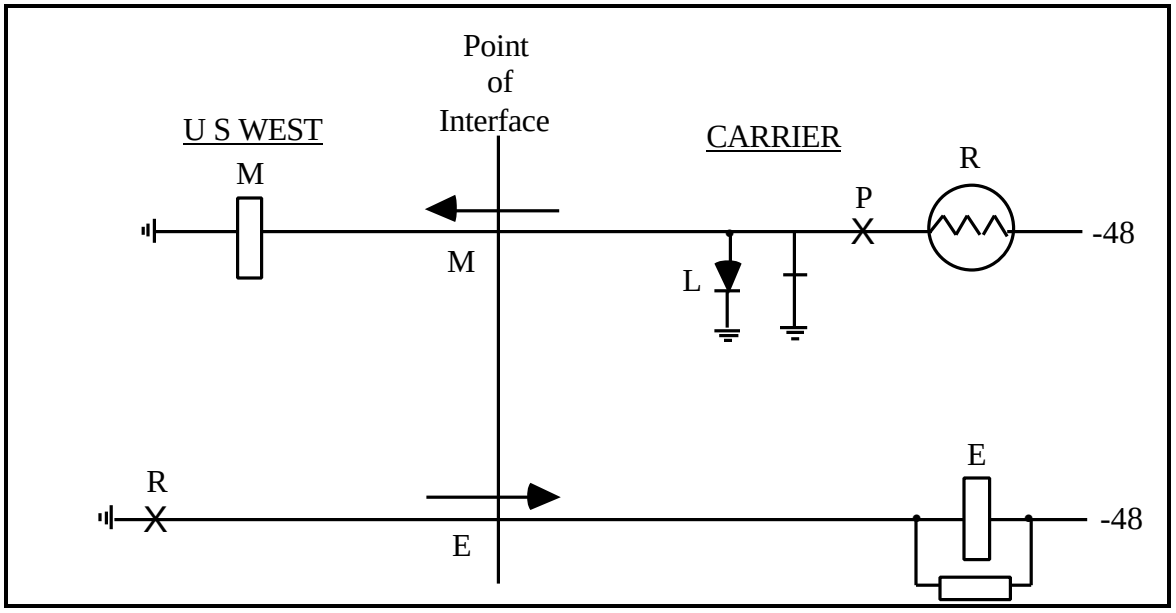


Figure 4-5 Type I E&M Interface

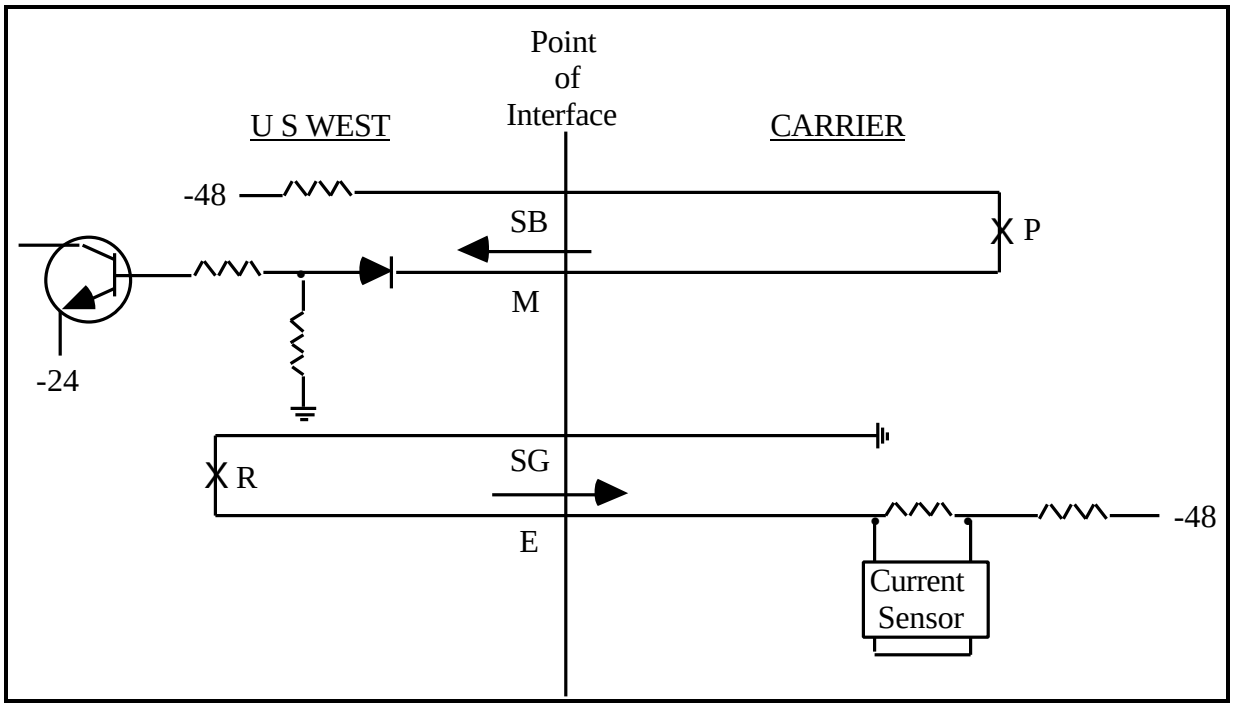


Figure 4-6 Type II E&M Lead Interface

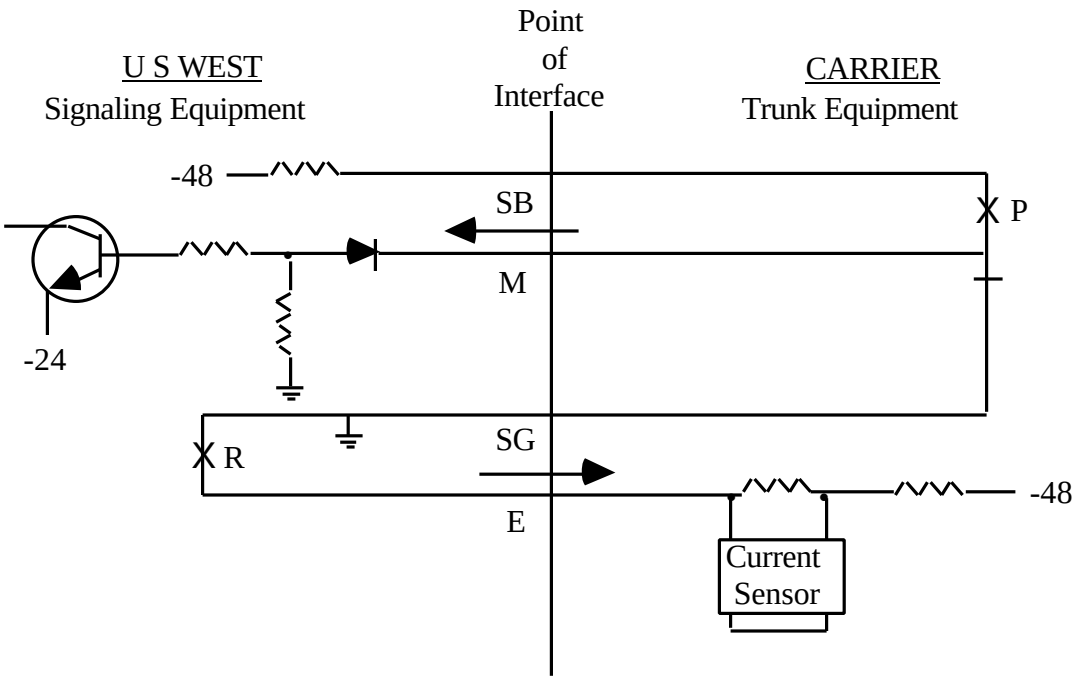


Figure 4-7 Type III E&M Lead Interface

5. Physical Characteristics Multiplexed Interfaces

5.1 General

This publication attempts to characterize the U S WEST Carrier interface as completely and accurately as possible. However, characteristics of equipment utilized by U S WEST to provide service in some locations may differ from the characteristics described and the facilities may not be available in all locations. When cases arise that have not been addressed in this document, U S WEST, the equipment manufacturer/supplier and the Carrier should cooperate to resolve any resultant problems.

5.2 Digital Time Division Multiplexed Signals

5.2.1 Megabit/Second Line Signal

The 1.544 Mb/s pulse code modulation line signal consists of 24 8-bit words and one framing bit per frame. Figure 5-1 illustrates a portion of this signal. The 8-bit words carry the enclosed value of a pulse amplitude modulation sample from one voice channel and the signaling information associated with that voice channel. The eighth bit of each word is used for signaling in one frame out of six.

The sampling rate for individual voice channels is 8000 samples per second. One hundred ninety three bits per frame at a repetition rate of 8000 per second gives the DS-1 line rate of 1.544 Mb/s.

The digital signal at the Point Of Interface (POI) is bipolar; i.e, adjacent marks are of opposite polarity which is sometimes referred to as alternate mark inversion.

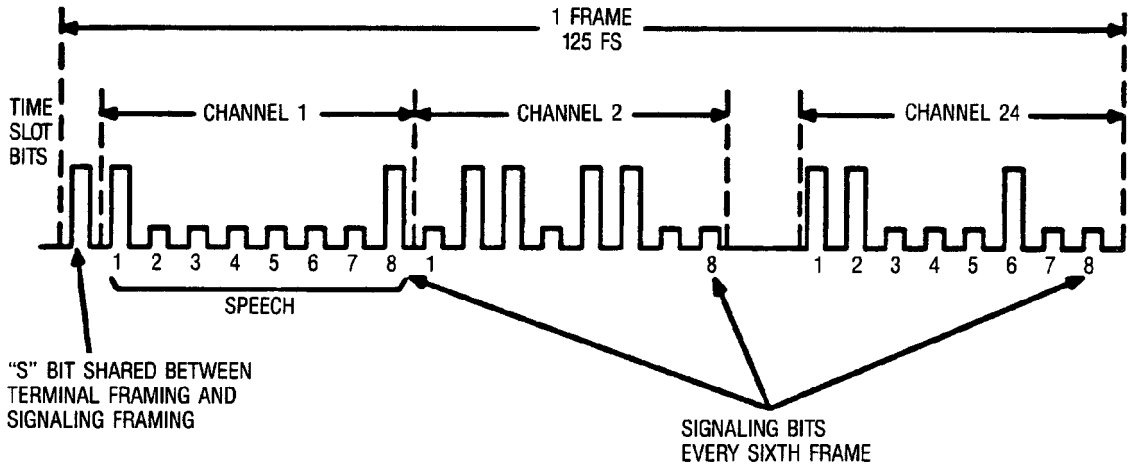


Figure 5-1 Frame Organization

5.2.2 DSX-1 Interface

The interface will be a 1.544 Mb/s digital signal at the POI which conforms with the DSX-1 interconnection specification presented in Table 5-1. Where appropriate equipment is available, the shape of an isolated pulse will fall within the shaded area of Figures 5-2 or 5-3. Tables 5-2 and 5-3 lists the corner points for these pulse templates.

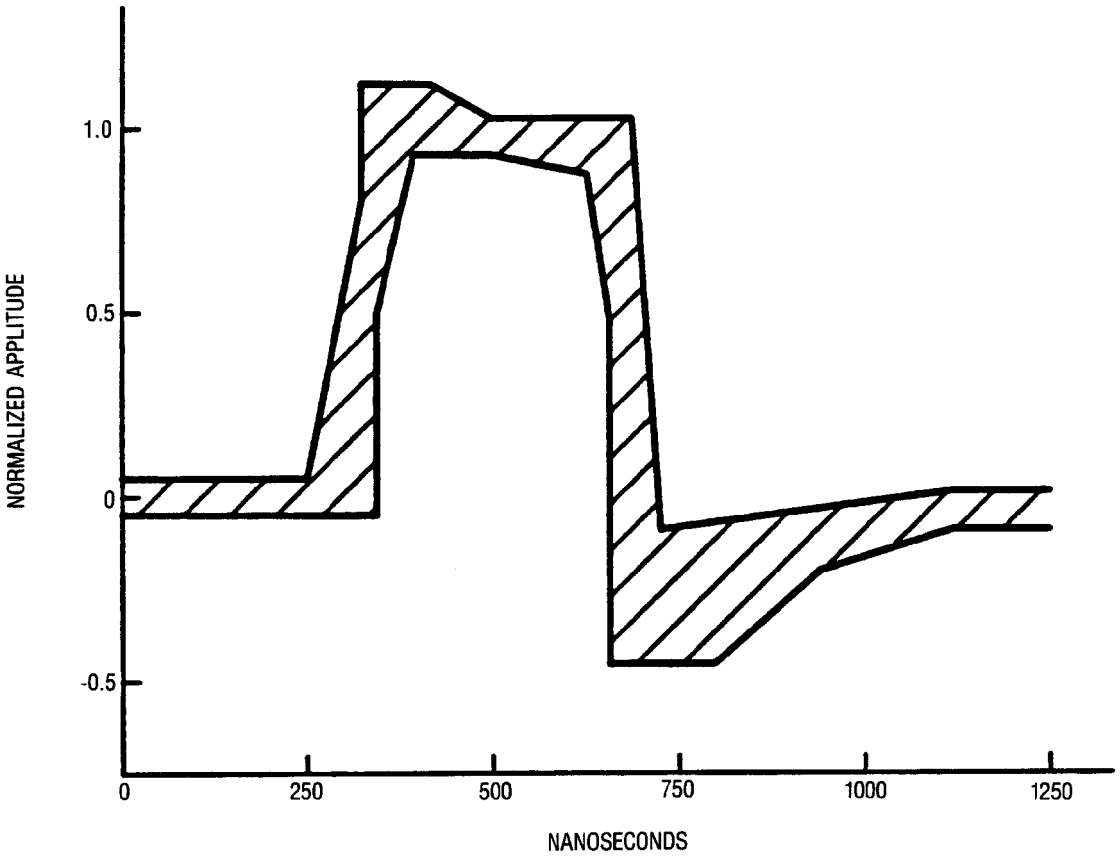


Figure 5-2 Isolated Pulse Template For New Equipment

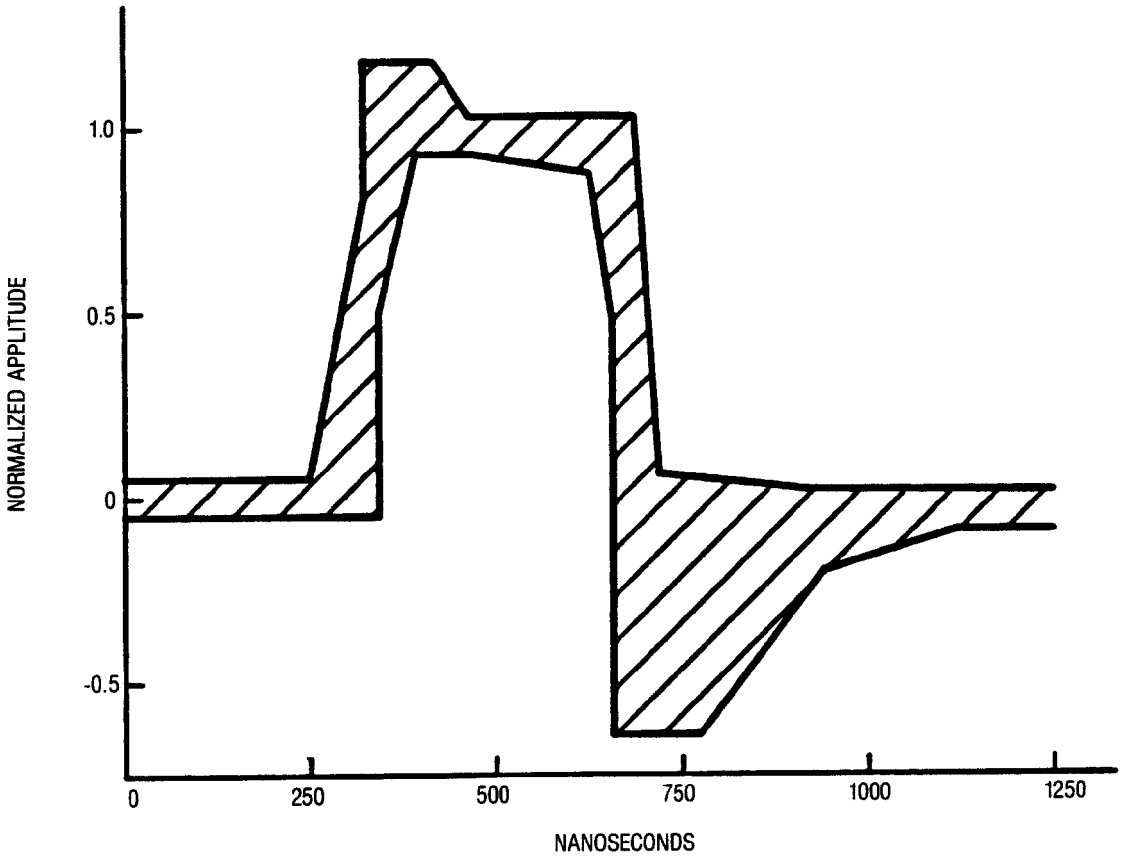


Figure 5-3 Isolated Pulse Template For Existing Equipment

Table 5-1 DSX-1 Interconnection Specification

Line rate:	1.544 Mb/s +- 50 ppm*(free running)
Line Code:	Bipolar with at least 12.5 percent average ones density and no more than 15 consecutive zeros.
Test load:	100 ohm resistive
Pulse shape:	An isolated pulse shall fit the template shown in Figures 5-2 and 5-3. The pulse amplitude shall be between 2.4 and 3.6 V and may be scaled by a constant factor to fit the template.
Power levels:	For an all-ones transmitted pattern, the power in a 2 kHz band about 772 kHz shall be 12.6 - 17.9 dBm and the power in a 2 kHz band about 1544 kHz shall be at least 29 dB below that in a 2 kHz band about 772 kHz.
Pulse	There shall be less than 0.5 dB difference inbalance: between imbalance: the total power of the positive pulses and of the negative pulses.

*Variations up to +- 130 ppm may be applicable.

Table 5-2 Pulse Template Corner Points For New Equipment

MAXIMUM CURVE	MINIMUM CURVE
(0, 0.05)	(0, -0.05)
(250, 0.05)	(350, -0.05)
(325, 0.8)	(350, 0.5)
(325, 1.15)	(400, 0.95)
(425, 1.15)	(500, 0.95)
(500, 1.05)	(600, 0.9)
(675, 1.05)	(650, 0.5)
(725, -0.07)	(650, -0.45)
(1100, 0.05)	(800, -0.45)
(1250, 0.05)	(925, -0.2)
(1100, -0.05)	
(1250, -0.05)	

Table 5-3 Pulse Template Corner Points For Existing Equipment

MAXIMUM CURVE	MINIMUM CURVE
(0, 0.05)	(0, -0.05)
(250, 0.05)	(350, -0.05)
(325, 0.8)	(350, 0.5)
(325, 1.22)	(400, 0.95)
(425, 1.22)	(475, 0.95)
(500, 1.05)	(600, 0.9)
(675, 1.05)	(650, -0.62)
(720, 0.08)	(775, -0.62)
(875, 0.05)	(925, -0.2)
(1250, 0.05)	(1100, -0.05)
	(1250, -0.05)

5.2.3 Framing

Structure of Individual Frame

- The framing bit occupies the first pulse position in each 193-bit frame. It is used for three, and sometimes four, purposes.
- It marks the beginning of the time slot for channel 1 so the pulses associated with each channel may be identified.
- It identifies the frames in which the eighth bit of each word contains signaling information.
- It distinguishes sequential signaling frames so that 2, 4, or 16 signaling states may be derived per voice channel.
- It is sometimes used for the transmission of data unrelated to the voice channels.

Structure of D4 Type Frame Format

- In D4-type frame format, half of the framing bits (the framing position in every other frame) are used for channel framing (Figure 5-4). The remaining framing bit positions are used to designate signaling frames.
- Looking at a superframe in the D4-type frame format with individual frames numbered 1 through 12, the channel framing pattern is:

Frame number in superframe - 1 2 3 4 5 6 7 8 9 10 11 12

Bit in framing position - 1 0 1 0 1 0

- A slightly different pattern is used for framing the signaling information. In the same superframe, the signaling framing pattern is:

  Frame number in superframe - 1 2 3 4 5 6 7 8 9 10 11 12

  Signaling framing - 0 0 1 1 1 0

- The first frame with a "1" signaling framing bit is the "A" signaling frame and the first frame with a "0" signaling framing bit is the "B" signaling frame.
- The framing bit pattern for D4-type frame format is summarized in Table 5-4.

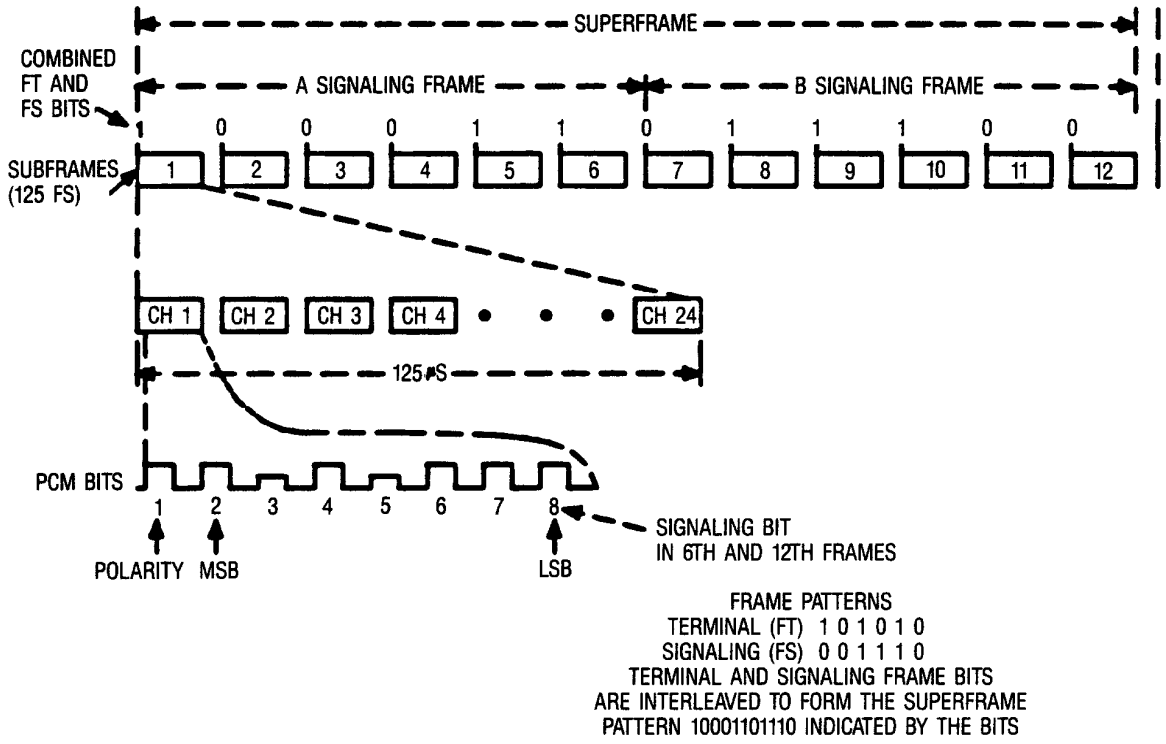


Figure 5-4 D4 Frame Organization

Table 5-4 Assignment of S-Bit for 12 Frame Superframe

FRAME NUMBER	S-BIT TERMINAL FRAMING F_T	S-BIT SIGNALING FRAMING F_S	INFORMATION CODING BITS	SIGNALING BIT	SIGNALING BIT
1	1	-	1-8	-	
2	-	0	1-8	-	
3	0	-	1-8	-	
4	-	0	1-8	-	
5	1	-	1-8	-	
6	-	1	1-7	8	A
7	0	-	1-8	-	
8	-	1	1-8	-	
9	1	-	1-8	-	
10	-	1	1-8	-	
11	0	-	1-8	-	
12	-	0	1-7	8	B

Structure of Extended Frame Format

- The following is the extended frame format (24-frame superframe).

- In the D4-type framing format, the framing pattern is generated by interleaving the terminal frame 101010 pattern and the signaling frame 001110 pattern. A similar interleaving (time multiplexing) of signals occurs for the extended frame format except that three signals will be combined. The three signals are:
  - 2 kb/s framing pattern 001011
  - 2 kb/s cyclic redundancy check
  - 4 kb/s data link

2 kb/s Framing Pattern

- As shown in Table 5-E beginning with frame 4 (extended superframe bit 579), the framing bit of every fourth frame forms the pattern 001011...0010111. This pattern is used to determine mainframe, superframe and robbed bit signaling synchronization. Mainframe synchronization is used to locate the 24 DS-0 channels of each frame. Superframe synchronization is used to identify where each particular frame is located within the superframe. This information is used to extract the cyclic redundancy check and the data link information as well as to identify those frames that contain robbed bit signaling (frames 6, 12, and 24).

Table 5-E Extended Superframe (ESF) F-Bit Assignments of the Extended Framing Format

ESF FRAME NUMBER	F-BITS				ROBBED BIT SIGNALING		
	ESF BIT NUMBER	ASSIGNMENTS					
		FPS	FDL	CRC	2 STATE	4 STATE	16 STATE
1	0	—	m	—			
2	193	—	—	CB_1			
3	386	—	m	—			
4	579	0	—	—			
5	772	—	m	—			
6	965	—	—	CB_2	A	A	A
7	1158	—	m	—			
8	1351	0	—	—			
9	1544	—	m	—			
10	1737	—	—	CB_3			
11	1930	—	m	—			
12	2123	1	—	—	A	B	B
13	2316	—	m	—			
14	2509	—	—	CB_4			
15	2702	—	m	—			
16	2895	0	—	—			
17	3088	—	m	—			
18	3281	—	—	CB_5			
19	3474	—	m	—			
20	3667	1	—	—			
21	3860	—	m	—			
22	4053	—	—	CB_6			
23	4246	—	m	—			
24	4439	1	—	—	A	B	D

2 kb/s Cyclic Redundancy Check

- The cyclic redundancy check is a method of performance monitoring that is contained within the F-bit position of frames 2, 6, 10, 14, 18, and 22 of every superframe (see Table 5-5). Because the cyclic redundancy check is an information pattern within the DS-1 bit stream, it can be transmitted through the digital hierarchy and monitored at any DS-1 level access point.

4 kb/s Data Link

- Beginning with frame 1 (extended frame format bit 0) of the superframe (see Table 5-5), every other 193rd bit is part of the 4 kb/s data link. This data link will provide a communication path between DS-1 terminals via the BX.25 level 2 protocol specified in PUB 54001, "Operations Systems Network Communications Protocol Specifications," June 1980. Some applications of the data link under consideration are protection switching, alarms and loopback, received line performance, supervisory signaling, channel unit provisioning, network configuration information, and general maintenance information.

Channel Assignment

- The voice frequency channels in the DS-1 signal that U S WEST delivers to the POI will be numbered in the same order as their time slots. It is expected that the Carrier will number its voice frequency channels in a corresponding manner.

5.3 Alarms

U S WEST will process the 1.544Mb/s signal received from the Carrier with equipment synchronized to the incoming signal. When the difference between expected frame bits and the received bits is in the range of 2 out-of 5 to 2 out-of 4, the receiving equipment will detect that synchronization is lost and initiate a reframe procedure. The maximum average reframe time will be less than 50 ms in the absence of errors (Maximum average reframe time is the average time to reframe when the maximum number of bit positions must be examined for the framing pattern). If successful reframe is not achieved within a period of 2 to 3 sec., the terminal equipment enters an alarm condition. This alarm is called a Carrier failure alarm (CFA). When the terminal equipment enters this alarm condition, it informs the Carrier by transmitting a yellow alarm signal. Figure 5-5 indicates timing parameters for the CFA system.

A terminal subjected to intermittent loss of synchronization will initiate an alarm after a period of integration of the short outages. This will be done in the following or an equivalent manner. On detection of an out-of-frame condition, an integration of time starts that produces an alarm after 2 to 3 sec. of continuous loss of synchronization. If the terminal regains synchronization, the integrator will delay at a slope of 1/4 to 1/15 of the rise slope.

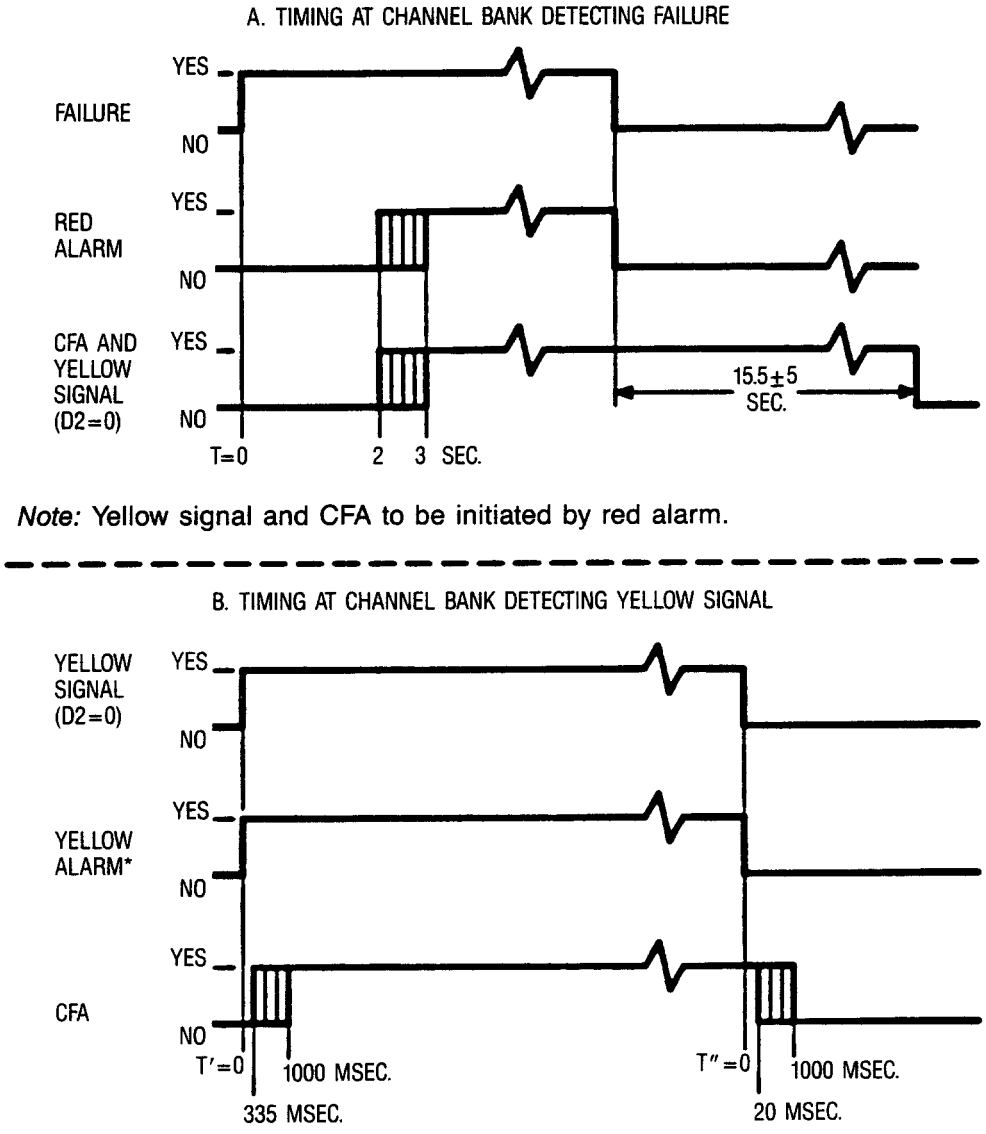


Figure 5-5 Carrier Failure Alarm (CFA) Timing

5.3.1 D4-Type Frame Format Yellow Alarm

In the D4-type frame format, U S WEST will send a yellow alarm by forcing the second bit to zero in all channels. When U S WEST is able to synchronize, it will stop sending the yellow alarm signal and resume DS-1 communication in 15 (+-5) seconds. If the Carrier sends a similar yellow alarm signal, U S WEST will recognize that the Carrier is out of synchronization and will terminate DS-1 communication until the yellow alarm is no longer received (See Figure 5-5).

5.3.2 Extended Frame Format Yellow Alarm

In the extended frame format, U S WEST will send a yellow alarm signal in the 4 kb/s data channel. U S WEST will also recognize a yellow alarm signal transmitted by the Carrier in the 4 kb/s data channel. This signal is an 8 "ones" and 8 "zeros" repeating pattern.

5.4 Eight-Bit Pulse Code Modulation Words

5.4.1 General

As noted in Section 2, the 8-bit words in a channel time slot carry encoded pulse amplitude modulation samples from a voice band signal. The pulse amplitude modulation samples are encoded in 8-bit pulse code modulation in 5 frames out of 6 and in 7-bit pulse code modulation in the sixth frame. The following paragraphs describe the pulse amplitude modulation sample amplitude. U S WEST will interpret pulse code modulation words from the Carriers as though they were encoded by the same rules.

The compression law used in the channel bank will be a precise piecewise linear approximation to a u-255 law which is defined by:

$$|y| = \frac{\ln(1+\mu|x|)}{\ln(1+\mu)} \quad \mu = 255$$

where x and y are respectively the compressor input and output, both normalized to unity. Figure 5-6 illustrates this companding characteristic.

5.4.2 Coder-Decoder (CODEC) Transfer Characteristics

The relationship between encoder decision levels and the decoder output levels is defined by specifying the CODEC transfer characteristic.

The characteristics, decision levels and code assignments include the effect of compression and expansion.

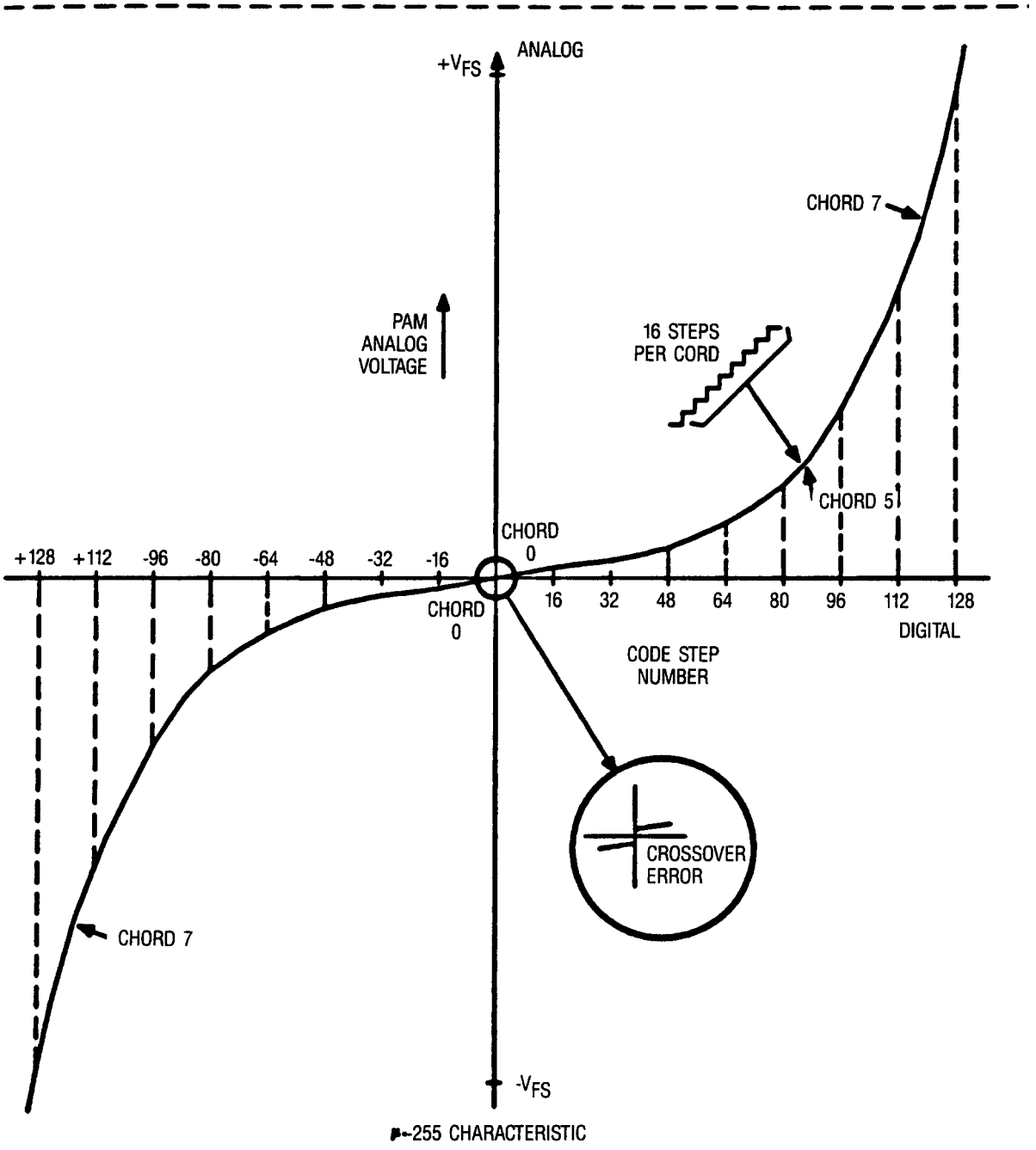


Figure 5-6 Nonlinear Companding Characteristic of the Decoder

To minimize distortion, the transfer characteristic for the abbreviated 7-bit words (used during signaling frames) differs from that for the normal 8-bit pulse code modulation words.

Figure 5-7 shows the transfer characteristic for normal 8-bit code modulation words. The output levels (Yn's) are always midway between the decision levels (Xn's) (this can be termed a "decision level assignment" CODEC). The output levels are given by:

$Y_0 = X_0 = 0$

$$Y_n = \frac{X_n + X_{n+1}}{2} \quad ;n = 1,2...127$$

Figure 5-8 shows the transfer characteristic for abbreviated 7-bit pulse code modulation words in the signaling frame. Except for the level closest to zero, the output levels (Zn's) are also midway between the decision levels (Xn's). These output levels are given by:

$$Z_n = X_{2n-1,} \quad n = 1,2,...64$$

5.4.3 Decision Levels

Figure 5-9 lists the relative magnitudes of the decision levels. The decision levels are placed symmetrically about zero.

The maximum decision level magnitude given in Figure 5-8 has been normalized to 8159 so that all magnitudes may be represented by integer values. The magnitude of the peak value of a +3 dBmo, 1 kHz single-frequency signal is slightly less than that of the largest decision level. This results from the definition of a digital milliwatt.

5.4.4 Code Assignments

The assignments of pulse code modulation code words and decoder levels are specified in Figure 5-10 in terms of coding ranges (decision levels).

The code assignment provides a sign and ones complement magnitude coding, resulting in a high ones density in the output data stream for encoding of speech.

The W-bits as defined in Figure 5-10 (pulse code modulation words column) are required to guarantee that the output data stream never includes more than 15 consecutive zeros. This output data stream requirement is related to T1 line clock recovery.

Bipolar 8 "zeros" substitution coding (B8ZS) will also be used to satisfy line code restrictions.

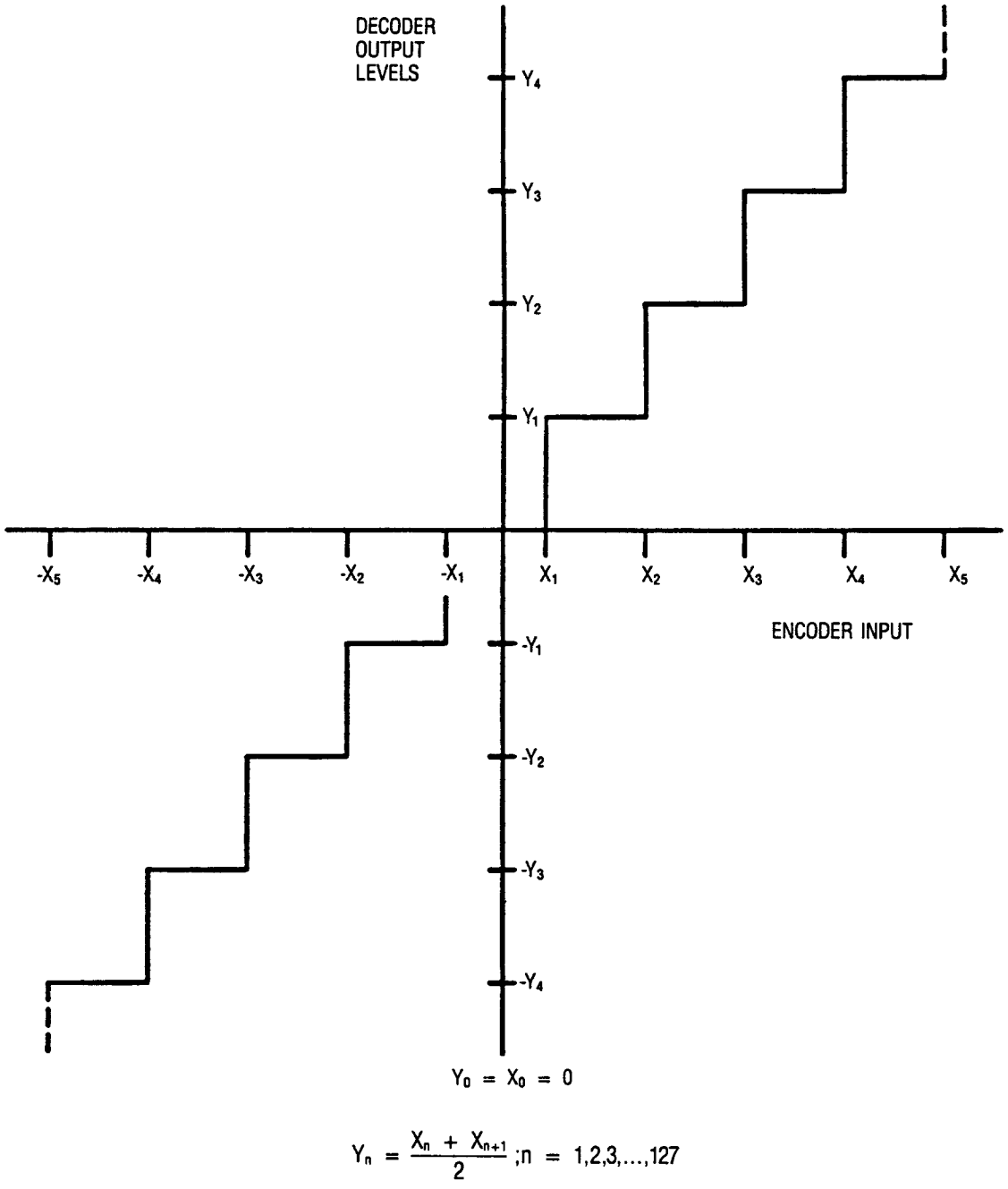


Figure 5-7 CODEC Transfer Characteristics Information Frame

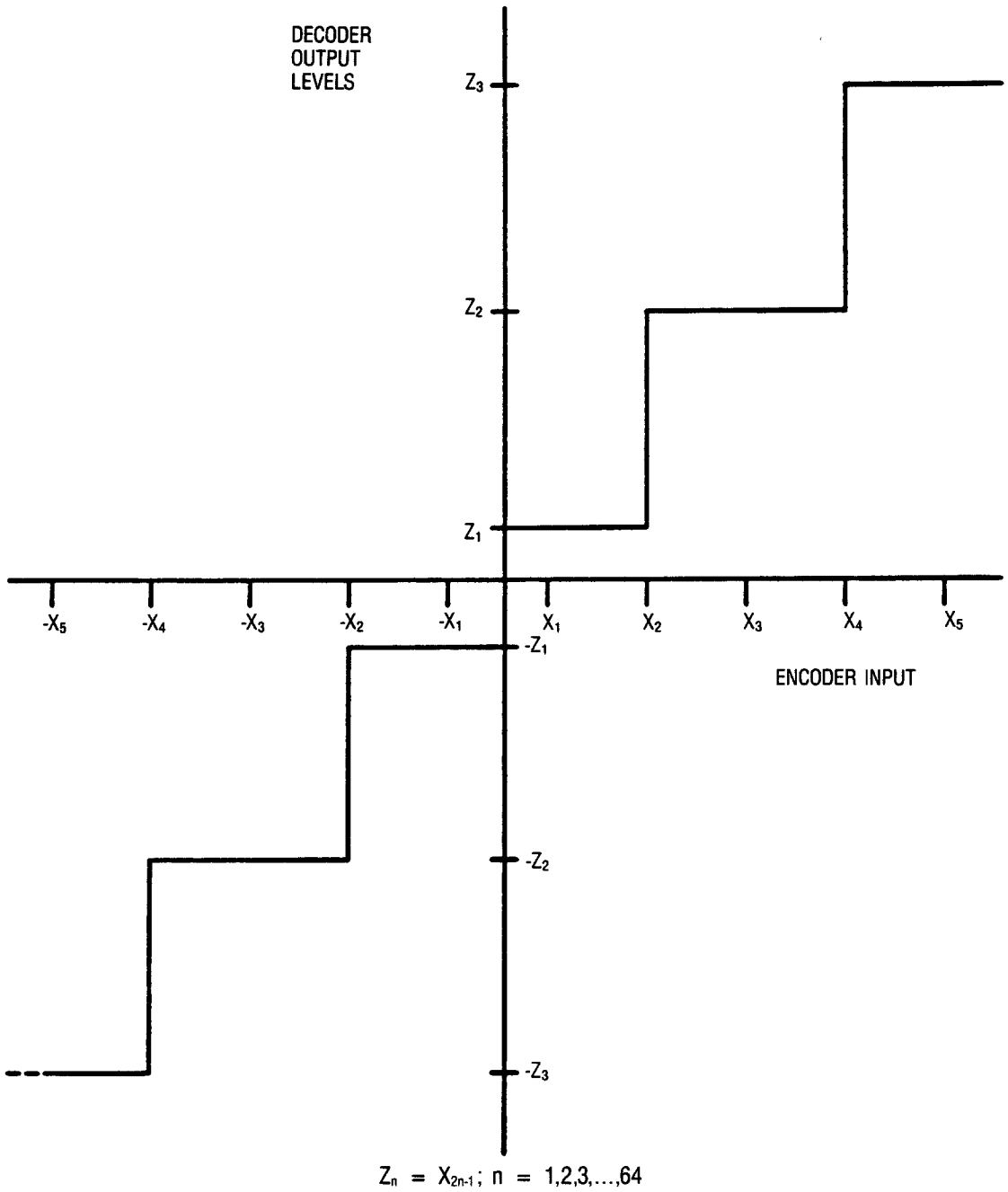


Figure 5-8 CODEC Transfer Characteristic Signaling Frame

LEVEL NUMBER n	LEVEL MAGNITUDE* X_n
0	0
1 n 16	2n - 1
17 n 32	4n - 33
33 n 48	8n - 161
49 n 64	16n - 545
65 n 80	32n - 1569
81 n 96	64n - 4129
97 n 112	128n - 10273
113 n 128	256n - 24609

*Normalized to lie in range of 0 to 8159 Units

Figure 5-9 Code Decision Levels

CODING RANGES	PCM WORDS** 1 2 3 4 5 6 7 8	DECODER LEVELS	
		INFORMATION FRAME	SIGNALING FRAME
X_{127},X_{128}	1 0 0 0 0 0 0 0	Y_{127}	
X_{126},X_{127}	1 0 0 0 0 0 0 1	Y_{126}	Z_{64}
. . .	. . .*	. . .	. . .
X_{n+1},X_{n+2}	(255-(n-1)) Modulo 2	Y_{n+1}	
X_n,X_{n+1}	(255-n) Modulo 2	Y_n	$Z_{(n+2)/2}$
. . .	. . .*	. . .	. . .
X_3,X_4	1 1 1 1 1 1 0 0	Y_3	
X_2,X_3	1 1 1 1 1 1 0 1	Y_2	Z_2
X_1,X_2	1 1 1 1 1 1 1 0	Y_1	
X_0,X_1	1 1 1 1 1 1 1 1	Y_0	Z_1
$X_0,-X_1$	0 1 1 1 1 1 1 1	Y_0	
$-X_1,-X_2$	0 1 1 1 1 1 1 0	$-Y_1$	$-Z_1$
$-X_2,-X_3$	0 1 1 1 1 1 0 1	$-Y_2$	
$-X_3,-X_4$	0 1 1 1 1 1 0 0	$-Y_3$	$-Z_2$
. . .	. . .*	. . .	. . .
$-X_n,-X_{n+1}$	(127-n) Modulo 2	Y_n	
$-X_{n+1},-X_{n+2}$	(127-(n+1)) Modulo 2	Y_{n+1}	$-Z_{(n+2)/2}$
. . .	. . .*	. . .	. . .
$-X_{124},-X_{125}$	0 0 0 0 0 0 1 1	$-Y_{124}$	
$-X_{125},-X_{126}$	0 0 0 0 0 0 1 0	$-Y_{125}$	$-Z_{63}$
$-X_{126},-X_{127}$	0 0 0 0 0 0 W_1 1	$-Y_{126}$	
$-X_{127},-X_{128}$	0 0 0 0 0 0 W_2 0	$-Y_{125}$	$-Z_{64}$ OR $-Z_{63}$

DEFINITION OF W-BITS

INFORMATION FRAME		SIGNALING FRAME			
W_1	W_2	SIG BIT	W_1	W_2	DECODER LEVEL
0	1	1	0	0	Z_{64}
		0	1	1	Z_{63}

*Codes change in normal binary sequence.
**During signaling frame, the eighth bit carries signaling information and the PCM word consists of bits 1 to 7.

Figure 5-10 Assignment of Transmitted Codes and Decoded Levels

5.4.5 Standard Level Digital Signal - Digital Milliwatt

The repetitive transmission of the following sequence of codes in a given channel will be decoded in a properly aligned receiving terminal as a 0 dBmo, 1 kHz signal.

DIGIT NO.	1	2	3	4	5	6	7	8
	0	0	0	1	1	1	1	0
	0	0	0	0	1	0	1	1
	0	0	0	0	1	0	1	1
	0	0	0	1	1	1	1	0
	1	0	0	1	1	1	1	0
	1	0	0	0	1	0	1	1
	1	0	0	0	1	0	1	1
	1	0	0	1	1	1	1	0

An input of 0 dBmo, 1 kHz sinusoidal signal to a channel of a properly aligned transmitting terminal will be encoded such that a 0 dBmo, 1 kHz signal is produced in the same as that produced by the digital milliwatt.

5.4.6 Equipped Channels

When the analog input of an equipped channel in the channel bank is terminated in an appropriate idle channel impedance (with no speech or other signal energy present), the code words emitted for that channel time slot must correspond to a near-zero voltage signal. This prevents excessive interference with digital processing equipment that may be used in the digital network.

The requirement is that the code words corresponding to signals of either polarity, of magnitude greater than X16 (Figures 5-9 and 5-10) are prohibited when the input to the channel is terminated with the appropriate impedance.

The objective should be to keep the bias such that the code words in the terminated condition are no greater than X12.

5.4.7 Unequipped Channels

When a channel position in the channel bank is unequipped (unit removed or never installed), the code word(s) emitted for that channel time slot must correspond to a near-zero voltage signal. This correspondence minimizes the dc stress on the receiving channel unit filter (if present) in the remote terminal during the time the transmitting position is unequipped in the near terminal.

The long term presence of high level dc signals can permanently degrade certain channel unit components. Therefore, it is recommended that any connecting bank also emit code words corresponding to a near zero decoded signal for an unequipped condition. In particular, code words corresponding to signals of either polarity and of magnitude greater than X48 (Figures 5-9 and 5-10) are prohibited in time slots for unequipped channel positions.

5.4.8 Unequipped Channel-Signaling

D4-Type Frame Format

- An unequipped channel must result in a 1 in the "A" signaling channel bit position in the DS-1 signal.

Extended Frame Format

- An unequipped channel must result in a 1 in the "A" and "C" signaling bit positions in the DS-1 signal.

5.5 Robbed Bit Signaling

Section 4 addressed the methods for conveying individual channel supervision (signaling) across the interface. In digital multiplexed interfaces, voice channel supervision is usually carried on specified bits in the digital signal. The built in signaling arrangement uses the eighth bit of the pulse coded modulation words associated with a channel time slot as shown in Tables 5-4 and 5-5. The logical state of the bits in the signaling positions are directly related to the signaling states on Carrier derived voice channels.

5.5.1 D4-Type Frame Format

In D4-Type frame format there are two signaling pulse positions per channel per superframe. Each of these 2 bits may have either of 2 values; hence, four distinct signaling states may be transmitted to each superframe. In some applications all four states are required but for switched access trunks only tow supervisory states (on-hook and off-hook) are required. When 2-state signaling is being used, the same signaling state must be transmitted in both A and B frames. For the digital signal delivered by U S WEST to the POI, the relationships between the trunk supervisory states and the signaling bits on the digital line are shown in Figure-5-11.

SIGNALING MODE	SUPERVISORY STATE	TRANSMITTED SIGNALING BITS A	B
E&M LEAD	M LEAD GROUNDED OR OPEN	0	0
	M LEAD BATTERY	1	1
LOOP REVERSE BATTERY - ORIGINATING			
	LOOP OPEN	0	0
	LOOP CLOSED	1	1
LOOP REVERSE BATTERY - TERMINATING			
	NORMAL BATTERY	0	0
	REVERSE BATTERY	1	1

Figure 5-11 Transmitted Signaling Bits

5.5.2 Extended Frame Format

The extended frame format provides four signaling bit positions per voice channel per superframe. Thus, the signaling capability is expanded to 16 states. These signaling states are illustrated in Table 5-5.

5.5.3 Synchronization

In all cases when the Carriers digital network is connected to U S WEST, the Carrier's digital network should be compatible with the hierarchical clock synchronization methods and stratum levels described in American Telephone and Telegraph Company (AT&T) Compatibility Bulletin 147 (CB147), "Engineering and Operations Plan for Synchronization of the Integrated Services Digital Network." CB147 was also published as United States Independent Telephone Association (USITA) Technical Advisory 58, Issue 4.

All timing information will be transmitted isochronously as part of the 1.544 Mb/s signal. A separate clock lead will not be provided.

For services in the Carrier premises to central office configuration, U S WEST will provide the Carrier with timing adequate for the specific application - either independent timing, or timing traceable to the Bell System reference frequency. If Bell System reference frequency timing is required but not available in a particular central office, the required special construction will be provided by U S WEST, at the expense of the Carrier.

In the event of loss of the incoming signal, the Carrier's equipment clock should be capable of free-running at a frequency which is within the electrical requirements of Table 5-1 and meets the appropriate specifications of CB147. Furthermore, the loop timing circuit should be capable of maintaining frequency lock in the presence peak-to-peak jitter on the outgoing 1.544 Mb/s signal should be no more than 0.1 time slot greater than that on the incoming signal.

5.5.4 Automatic Protection Switching

Automatic protection switching of local facilities used to provide 1.544 Mb/s circuits will improve circuit availability by automatically routing the Carrier's circuit via an alternate circuit path (generally along the same route). Manual or automatic protection is inherent in most interoffice digital facilities. However, unless the automatic protection switching option is selected, there will be no spare maintenance lines provided to the Carrier's premises.

6. Interface Configuration Tabulation

6.1 Group 1 Interfaces (2-Wire Voice Frequency)

Access channels with Group 1 interfaces will be provided only with U S WEST segments which are directly connected to end offices. Connections to access tandem switches or originating screening offices (OSO) are not provided.

6.1.1 One-Way Originating Trunks

Group 1 interfaces which have 2-wire transmission across the interface and are arranged for 1-way originating operation may be equipped with the following signaling methods at the option of the Carrier:

- Loop reverse-battery signaling
- E&M lead signaling - Type I (Note 1)
- E&M lead signaling - Type II (Note 1)
- E&M lead signaling - Type III (Note 1)

6.1.2 One-Way Terminating Trunks

The following signaling methods are available on 1-way terminating channels with Group 1 interfaces:

- Loop reverse-battery signaling
- E&M lead signaling - Type I (Note 1)
- E&M lead signaling - Type II (Note 1)
- E&M lead signaling - Type III (Note 1)

6.1.3 Two-Way Trunks

The only signaling arrangement available on 2-way trunks is E&M lead signaling.

6.2. Group 2 Interfaces (4-Wire Voice Frequency)

Access channels with Group 2 interfaces may be directly connected to end offices, access tandem switches or OSO's.

6.2.1 One-Way Originating Trunks

The following signaling methods may be implemented at Group 2 interfaces on 1-way originating trunks:

- Simplexed loop reverse-battery signaling (Note 2)
- E&M lead signaling - Type I (Note 2)
- E&M lead signaling - Type II (Note 2)
- E&M lead signaling - Type III (Note 2)

6.2.2 One-Way Terminating Trunks

The following signaling methods are available on 1-way terminating channels with Group 2 interfaces:

- Simplexed loop reverse-battery signaling (Note 1)
- E&M lead signaling - Type I (Note 2)
- E&M lead signaling - Type II (Note 2)
- E&M lead signaling - Type III (Note 2)

6.2.3 Two-Way Trunks

The only signaling arrangement available on 2-way trunks ins E&M lead signaling.

6.3. Group 6 Interfaces (1.544 Megabits Per Second)

Voice frequency channels which are time division multiplexed into a 1.544 Mb/s digital signal may be used to implement trunks directly accessing end offices or trunks to an access tandem. The signaling bits in the digital signal provide individual channel signaling information comparable to E&M lead signaling. The derived voice frequency channels may be connected to switching trunk circuits using either loop or E&M lead signaling.

Notes:

- Transmission levels of +7, -16 dB transmission level point is available only through the placement of U S West signaling equipment at the Carrier POP.
- E&M lead signaling requires the placement of U S WEST signaling equipment at the Carrier POP.

7 Definitions

7.1 Acronyms

AMA	Automatic Message Accounting
ANI	Automatic Number Identification
CCS	Common Channel Signaling
CFA	Carrier Failure Alarm
CODEC	Coder-Decoder
DAL	Dedicated Access Line
DNIS	Directory Number Identification Service
DTMF	Dual Tone Multi-frequency
IC	InterLATA Carrier
LATA	Local Access and Transport Area
MF	Multi-frequency
MFJ	Modification of Final Judgement
OSO	Originating Screening Office
POI	Point of Interface
POP	Point of Presence
SAC	Service Access Code
SSP	Service Switching Point
USITA	United States Independent Telephone Association

7.2 Glossary

Access Tandem

An access tandem is a U S WEST switching system that provides a traffic concentration and distribution function for interLATA traffic originating/terminating within a local access and transport area (LATA). The access tandem provides the interLATA Carrier with access to more than one end office within the LATA.

Automatic Number Identification (ANI)

ANI is a provision of the billing number associated with the line from which the call originated.

Carrier

The term Carrier is used to denote an 800 Service subscriber. The interfaces described within this document will be utilized for all Carriers, including the American Telephone and Telegraph (AT&T) Carriers, who subscribe to 800 Service access.

Coin Line

A coin line is a line with a "coin" class of service. Lines of this class of service are connected to public and semi-public coin telephones.

Coinless

See Non-Coin

Common Channel Signaling (CCS)

Common Channel Signaling permits a large number of speech circuits to be controlled by only one signaling link, which is separate from the speech circuits. In addition to call control signaling, the signaling link can also carry information for network management and maintenance. U S WEST will deploy CCS using Signaling System No. 7.

End Office

An end office is a U S WEST switching system within a local access and transport area (LATA) wherein customer station loops are terminated for purposes of interconnection to each other and to trunks.

End Users

Customers who use (rather than provide) telecommunications services, i.e., those who either originate or terminate telecommunications are end users.

End-User Access Line

An end user access line is the facility between the end office and the network interface at the end-user's premises. The end-user access line includes certain non-traffic sensitive central office equipment, the outside plant facilities, the network channel terminating equipment (when necessary), and the network interface located on the end-user's premises. For the purposes of this document, an end user access line is considered to be switched access.

Equal Access (North American) Signaling

Equal access signaling as used in this publication refers to one of the two signaling methods described in Section 3.

InterLATA

InterLATA is a term used to describe services, revenues, functions, etc., that relate to telecommunications originating in one local access and transport area (LATA) and terminating in another LATA or outside of a LATA.

InterLATA Carrier (IC)

See Carrier

InterLATA Carrier Demarcation Point

See Point OF Interface (POI)

IntraLATA

IntraLATA is a term used to describe services, revenues, functions, etc. that relate to telecommunications originating and terminating within a single LATA.

Local Access and Transport Area (LATA)

A LATA is a geographic area (called "exchange" or "exchange area" in the Modification of Final Judgment) which has been established by a U S WEST Operating Company.

Local Access and Transport Area (LATA) Access

LATA access is any activity or function performed by U S WEST in connection with the origination or termination of interLATA telecommunications for a Carrier. This includes, but is not limited to, the provision of network control signaling, answer supervision, automatic calling number identification, testing and maintenance of facilities, and the provision of information necessary to bill customers.

Local Serving Office

See End Office

Modification of Final Judgment

Modification of Final Judgment (MFJ) is the official name for the agreement reached between the Department of Justice and the American Telephone and Telegraph Company (AT&T) on January 8, 1982 and approved by the court on August 24, 1982. The MFJ replaces the 1956 Consent Decree and settles the 1974 antitrust case (United States versus AT&T).

Non-Coin Line

A non-coin line is a line which does not have a "coin" class of service. Classes of service for non-coin lines include hotel/motel, coinless, multiparty and others.

Non-Sent Paid Calls

Non-sent paid calls are not billed to the telephone number associated with the originating line.

Originating Screening Office (OSO)

Within the U S WEST service area, the OSO is an AT&T owned toll switch used for 800 Service call routing. In selected areas, U S WEST may be forced to lease switching capacity on the OSO to perform the 800-NXX switching and routing function until U S WEST acquires its' own switches or switching capacity.

Physical Characteristics

The term physical characteristics denotes quantitative and qualitative characteristics of physical systems (e.g., electrical and mechanical parameters).

Point Of Interface (POI)

A POI is a demarcation point between U S WEST and a Carrier. This point establishes the technical interface, the test point(s), and the point(s) of division of operational responsibility.

Point of Presence (POP)

The POP is a physical location within a local access and transport area (LATA) established by an interLATA Carrier for the purpose of obtaining LATA access from U S WEST. POP applies to both switched and dedicated access, although different POPs may be used for different services.

Service Access Code (SAC)

A service access code is a code of the form "NOO" which takes the place of an NPA in the dialing sequence in order to access a particular service provided by an interLATA Carrier, Bell Operating Company (BOC), or Non-Bell Exchange Company. Service access codes are associated with supplementary features which may be ordered by an interLATA Carrier under the appropriate access tariff.

Signaling System No. 7 (SS-7)

Signaling System No. 7 is the signaling protocol standard that will be used for the U S WEST CCS network.

Timed Reorder/Busy

This is the release of calls from reorder/busy tone and recorded announcements in the event that the calling customer does not abandon, as expected, within a reasonable length of time.

Traditional North American Signaling

Traditional North American Signaling as used in this document refers to one of the two signaling methods described in Section 3.

8. References

Publication Number	Title
PUB 61100	Description of the Analog Voiceband Interface Between the Bell System Local Exchange Lines and Terminal Equipment
PUB 61201	Compatibility Information for Feature Group D Switched Access Service
PUB 62500	Voice Grade Switched Access Service Transmission Parameter Limits and Interface Combinations
PUB 48501	Local Switching System General Requirements
PUB 41008	Analog Parameters Affecting Voiceband Data Transmission - Description of Parameters
PUB 41009	Transmission Parameters Affecting Data Transmission - Measuring Techniques
PUB 41451	1.544 Mbps Digital Service - Channel Interface Specifications
PUB 43801	Digital Channel Bank - Requirements and Objectives
PUB 43802	Digital Multiplexes - Requirements and Objectives
PUB 43803	Facility Maintenance features Required for Interoffice Digital Transmission Equipment

A. Signaling, Tones, and Announcements

A.1 Wink Signal

A.1.1 General

There are off-hook and on-hook wink signals. An off-hook wink is an off-hook pulse during the on-hook state.

A.1.2 Off-Hook Wink

The duration of standard off-hook winks from U S WEST will be from 100 ms to 350 ms and from the Carrier it must be from 140 ms to 290 ms.

- The start wink is an off-hook wink sent by the terminating end to indicate its readiness to receive multifrequency (MF) pulses. The end of the start wink must not occur until 210 ms after the receipt of the incoming seizure signal. The terminating end must ignore locally generated transients and be prepared to receive MF pulses 35 ms after the end of the start wink. If it is not, some digits could be missed.

  Exhibit A-1 shows a time diagram for wink start signaling.

- The acknowledgment wink is an off-hook wink sent by the terminating end to indicate that it has received the expected MF pulses.

- An on-hook wink sent to U S WEST to request the connection of an MF receiver for a forthcoming MF signal.

A.2. Multifrequency Codes

A.2.1 Multifrequency Codes

MF signaling is used to transmit numerical information and control signals across the point of interface (POI).

MF signaling arrangements make use of pairs of frequencies out of a group of six frequencies. These frequencies are 700, 900, 1100, 1300, 1500, and 1700 Hz. MF signals are used for called number address signaling, calling number identification, and ringback. The 15 possible frequency combinations are used to represent the digits 0 through 9, to indicate special control signals at the beginning and end of each pulse sequence and to send information signals.

The MF codes used with 800 Service Access are presented in Table A-1.

A.2.2 Requirements for MF Transmitters

The switching system, upon detecting the appropriate dc start signal, must transmit the required MF signals.

The transmitter and its signal must meet the following requirements:

- The two frequencies of each code must start and end within 1 ms of each other.

- The power output per frequency must be -7 =1 dBmo.
- There must not be over 1 dB difference between the powers of the two frequencies of any code.
- The total power of extraneous signal components must be at least 30 dB below the power level of either frequency of the code.
- The KP signal length must be 90 to 120 ms.
- The ST and digit signal lengths must each be 58 to 75 ms.
- The interval between signals must be 58 to 75 ms.
- The frequencies must be within = 1.5 percent of stated nominal values.
- The transmitter must have the same nominal impedance as the switching system in which it is used. When connected to a 4-wire Carrier channel or to the 4-wire port of a terminating set, the impedance must be 600 nonreactive.
- The transmitter must have a longitudinal balance to ground and a return loss at least equal to those required for voice transmission.
- During tone off periods transmitted power at any MF tone must not exceed -58 dBmo.

Table A-1 Multifrequency Codes

Frequencies in Hz	Digit or control signal
700,900	1
700,1100	2
700,1300	4
700,1500	7
700,1700	ST"" or ringback
900,1100	3
900,1300	5
900,1500	8
900,1700	ST"
1100,1300	6
1100,1500	9
1100,1700	KP
1300,1500	0
1300,1700	ST"
1300,1700	ST

A.2.3 Requirements for MF Receivers

At the receiving switching system, the MF receiver must be connected and activated as directed by appropriate dc control signals. The receiver must meet the following requirements:

The receiver must have the same nominal impedance as the switching system in which it is used. When connected to a 4-wire Carrier channel or the 4-wire port of a terminating set, the impedance must be 600 nonreactive. Its single frequency return loss must be at least equal to that required for voice transmission.

The receiver must respond to signal levels between 0 and -25 dBm per frequency. Existing receivers may have a sensitivity of only -22 dBm, but new circuits must meet the -25 dBm requirement. The receiver must not respond if the signal level drops below -25 dBm per frequency.

The receiver must not respond to address signals prior to being "unlocked" by receipt of a KP signal. Once unlocked, the receiver must remain unlocked until it receives the ST (ST', ST", or ST"') signal.

The receiver must respond to signals in which each frequency component duration is at least 30 ms. The receiver must respond to a KP signal that is at least 55 ms long and may respond if the KP signal is from 30 to 54 ms long. The two frequency components may be shifted in time relative to each other by as much as 4 ms.

- It is desirable that the receiver not respond to signals shorter than the requirements in the preceding paragraph, and it is required that it not respond to signals in which the two components are not coincident for more than 10 ms. The receiver must recognize interpulse intervals as short as 25 ms. This interval is defined as the time during which no signal frequency component is above -35 dBm. It is desirable that the receiver bridge interruptions as long as possible, consistent with meeting the interpulse requirement. It is required that it bridge interruptions up to 10 ms long after the minimum length signal has been received.

The receiver must accept up to 10 pulses per second.

The receiver must check for the presence of two, and only two, valid frequency components in each pulse. If a pulse fails to meet this requirement, the call must receive reorder treatment.

The receiver must tolerate pulses in which there may be as much as a 6 dB difference in power levels of the two frequency components . It is desirable that even greater level differences be tolerated.

The following types and levels of noise must be tolerated with an error rate of not more than 1 in 2500 10-digit calls.

- Message Circuit Noise:

  S/N 20 dB

- Impulse Noise:

  S/N -12dB (Test with Noise Tape 201 per PUB 56201)

- Power Line Induction.

  60 Hz 81 dBrnco

  180 Hz 68 dBrnco

The receiver must tolerate 2A-B and 2B-A modulation products caused by nonlinearities in transmission facilities. The power sum of these modulation products is expected to be at least 28 dB below each frequency component level of the signals.

The longitudinal balance to ground must be equal to that required for voice transmission.

The receiver must accept 700, 900, 1100, 1300, 1500, and 1700 Hz signals within the limits of =(1.5 percent +5 Hz).

A.3 Glare

A.3.1 Description

Two way trunks are subject to occasional simultaneous seizures at both ends because of the unguarded interval between the seizure of the trunk at one end and the consequent making busy of the trunk at the other end. This is called "glare." These simultaneous seizures cause each end of the trunk to receive a sustained off-hook signal.

In wink-start operation each office expects to see the other respond to a seizure by returning an off-hook wink signal. If the returned off-hook signal lasts beyond 350 ms, a glare condition will be interpreted. The glare timing will be kept near 350 ms in order to save system time.

A.3.2 Glare Resolution

Each stored program control switching system will have a glare bit, or equivalent, in memory for each 2-way trunk, or trunk group, which can be set by U S WEST to either 0 or 1. The glare bit will thus identify that office as the one to back out when glare is detected. U S WEST and the Carrier will decide which office will control and which will back out for each trunk or trunk group and then set the glare bits accordingly.

When glare is detected, the office will examine its glare bit to determine the action to resolve the condition. If the office finds it is the control office, it will wait for the informing off-hook state to change to an on-hook state. Then it will start outpulsing in the normal manner. If the office finds it is not the control office, the outgoing off-hook signal will be changed to an on-hook signal. The original outgoing call will be retried on another trunk.

All stored program control switching system will be able to detect and resolve glare on 2-way E&M lead trunks with wink start operation.

A.4 Call Progress Tones

A.4.1 Application

Call progress tones provide call setup status information to the originating customer about an attempt to establish a connection. They cover the interval from the end of dialing to the answer by the called customer or abandonment of the attempt. The progress tones may be passed to the Carrier by the terminating exchanged Carrier (U S WEST or other BOC) when the Carrier attempts to complete calls into aterminating local access and transport area (LATA).

A.4.2 Audible Ringing Tone

This tone is sent by the terminating exchange Carrier (U S WEST or other BOC) to indicate to the calling customer that an alerting signal is being sent on the called line. (Both signals are not necessarily sent simultaneously.)

Frequencies	440+480 Hz, nominal, maximum deviation =1.6 percent per frequency
Level	-19 dBm per frequency where applied to voice transmission path
Timing	Cycles of 2 s on, 4 s off (nominal), with = 10 percent tolerances on the timing parameters

A.4.3 Line Busy Tone

This tone is sent by U S WEST when the called line is reached but is either off-hook or already being alerted.

Frequencies	480 + 620 Hz, nominal, maximum deviation +1.5 percent per frequency
Level	-24 dBm per frequency where applied to voice transmission path
Timing	60 ppm (0.5 s on, 0.5 s off) with +10 percent tolerances on the timing parameters

A.4.4 Reorder Tone

This tone may be sent by any switch point in the end-to-end circuit path to indicate that the dialed 800-NXX is invalid or that the end office code is unassigned. In step-by-step switching systems, this signal may be sent if a vacant level is reached.

Frequencies	480 + 620 Hz, nominal, maximum deviation +1.5 percent per frequency
Level	-24 dBm per frequency where applied to voice transmission path
Timing	cycles of 0.5 s on, 0.5 s off, 0.5 s on, 1.5 s off, with +10 percent tolerances on the timing parameters

A.4.5 Vacant Code

This tone is sent by U S WEST on originating or teminating calls to indicate that the dialed 800-NXX is invalid or that the end office code is unassigned. In step-by-step switching systems, this signal may be sent if a vacant level is reached.

Frequencies	480 + 620 Hz, nominal, maximum deviation +1.5 percent per frequency
Level	-24 dBm per frequency where applied to voice transmission path
Timing	cycles of 0.5 s on, 0.5 s off, 0.5 s on, 1.5 s off, with +10 percent tolerances on the timing parameters

A.5 Recorded Announcements and Tones for Announcement Encoding

A.5.1 Application

Recorded announcements are used by U S WEST and the Carrier to inform the calling customer of special conditions of call setup. One use is for customers dialing unassigned (vacant) or disconnected addresses.

A.5.2 Text of Sample Announcement

Some of the most commonly used announcements are listed below with the conditions under which they are used. The full text of the announcement is played at least once unless the calling terminal sends and on-hook signal.

ANNOUNCEMENT	TEXT
N (No circuit or heavy traffic)	We're sorry, all circuits are busy now. Will you please try your call again later.
P (Equipment blockage)	We're sorry, your call did not go through. Will you please hang up and try your call again.
L (Vacant code)	We're sorry, your call cannot be completed as dialed. Please check the number and dial again or call your operator to help you.
Vacant number (a) Announcement machine equipped with operator intercept cut-through	We're sorry, you have reached a number that has been disconnected or is no longer in service. Please check the number and dial again, or stay on the line and an operator will answer you.
(b) Announcement machine not equipped with operator intercept cut-through	We're sorry, you have reached a number been disconnected or is no longer in service. If you feel you have reached this recording in error, please check the number or try your call again.

A.5.3 Identification of Party Causing Call Irregularity

In the post divestiture environment, any of the following parties may cause the irregularity that results in the failure of a call attempt:

- Customer (e.g., incorrectly dialed number)
- U S WEST (e.g., office failure)
- Carrier (e.g., trunk blockage within the Carrier network)

For both customer awareness and internal service evaluation purposes, it is desirable to be able to tell from the announcement which party was responsible for the irregularity. Therefore, tones and announcements will be assigned to incomplete call conditions in a manner that permits identification of the party responsible. Under the present arrangement, vacant code and intercept announcements identify customer caused problems; U S WEST no circuit announcement, recorder announcements and a reorder tone are used for U S WEST caused problems; and Carrier no circuit and Carrier reorder announcements are used for Carrier caused problems.

A.5.4 Special Information Tones for Recorded Announcement Encoding

Some recorded announcements are preceded by a series of three tones. The use of these tones facilities machine detection and processing of information relating to the announcements that follow the tones. The current application of special information tones (SIT) encoding utilizes the following six SITs:

Intercept	(ITC)
Vacant Code	(VC)
No circuit-U S WEST	(NC-USW)
Recorder-U S WEST	(RO-USW)
No Circuit-Carrier	(NC-CXR)
Recorder-Carrier	(RO-CXR)

To achieve this level of encoding two frequencies are assigned to the first tone in the SIT sequence, two frequencies to the second, and only one frequency to the third. The initial assignment of codes is designed to enhance detection reliability. To provide greater detection reliability, duration encoding is also utilized. The third tone in the sequence is assigned a fixed duration and a fixed frequency for all six SITs. This fixed assignment provides a reference or calibration point for detection devices.

The nominal frequency for the first tone is913.8 Hz or 985.2 Hz; for the second tone, 1370.6 Hz or 1428.5 Hz; for the third tone, 1776.7 Hz. The actual frequencies at the interface are within =2 percent of the nominal values in frequency shift and -0.2 percent in frequency flutter.

The nominal duration for each tone is either 274 ms or 380 ms at the point of application in the network. The duration may vary up to =5 percent of the nominal value at the point of application. However, the first tone may be significantly shorter than the nominal duration at the POI due to the clipping action of signal actuated devices in the network such as compandors and echo suppressors. The interval between two consecutive tones in less than 4 ms.

The nominal level for each frequency of an SIT should be -13 dBmo. The encoding scheme for the six SITs is shown below:

	First Tone		Second Tone		Third Tone	
	Freq. (Hz)	Duration (ms)	Freq. (Hz)(ms)	Duration (Hz)	Feq. (ms)	Duration
ITC	913.8	274	1370.6	274	1776.7	380
VC	985.2	380	1370.6	274	1776.7	380
RO-BOC	913.8	274	1428.5	380	1776.7	380
NC-BOC	985.2	380	1428.5	380	1776.7	380
RO-CXR	985.2	274	1370.6	380	1776.7	380
NC-CXR	913.8	380	1370.6	380	1776.7	380

A.6 Disconnect Sequences

A.6.1 Originating Calls (U S WEST to Carrier)

• Calling Customer Disconnects First

- As soon as the U S WEST end office determines that the calling customer has gone on-hook for sufficient time to indicate disconnect, the end office disconnects the line from the outgoing trunk, applies on-hook signal to the trunk, and makes the calling line available for another call. Trunk guard timing of 750 to 1000 ms is employed before making the outgoing trunk available for a new call.

• Called Customer Disconnects First

- When on-hook is observed on the trunk from the Carrier, the end office initiates 10- to 40-second timing. The connection between the line and the outgoing trunk is maintained. If the calling line goes on-hook, or if time-out occurs, the connection is released, and the on-hook signal applied to the trunk. After 750 to 1000 ms of trunk guard timing, the trunk is made available for a new connection. If the calling line is still off-hook after time-out, the off-hook is treated as a new call request.

A.6.2 Terminating Calls (Carrier to U S WEST)

• Calling Customer Disconnects First

- When an on-hook from the Carrier is detected, the end office disconnects the line from the incoming trunk and applies an on-hook signal to the trunk. The Carrier must guard the trunk for 750 to 1000 ms before using the trunk for a new call.

• Called Customer Disconnects First

- When a called customer on-hook is detected, the end office maintains the connection between the line and the incoming trunk, applies an on-hook signal to the trunk and initiates 10- to 40-second timing. As soon as on-hook is received on the trunk or time-out has occurred, the line is disconnected from the trunk, the on-hook signal applied to the trunk, and the called line made available for a new call. After 750 to 1000 ms of trunk guard timing, the trunk must be made available for use in a new call.

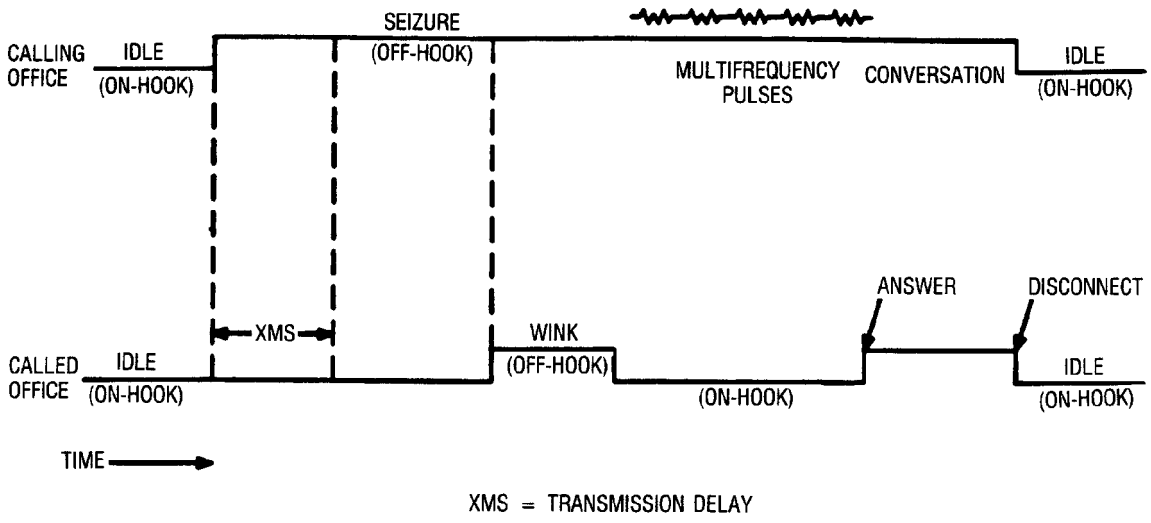


Exhibit A-1 Wink Start Signaling