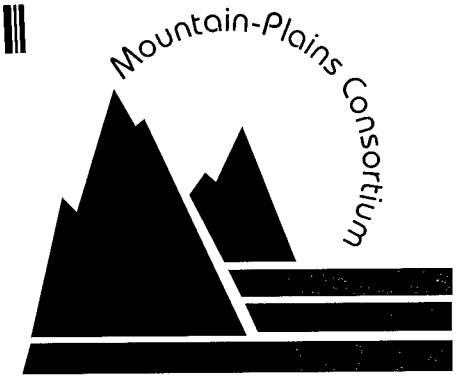

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Peer-to-Peer Desktop Video Conferencing Final Report, Phase II

Thad E. Senti
William J. Grenney
Newell W. Crookston

February 1998

Colorado State University
Fort Collins, Colorado

North Dakota State University
Fargo, North Dakota

University of Wyoming
Laramie, Wyoming

Utah State University
Logan, Utah

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The Utah Department of Transportation (UDOT) recently investigated the cost and effectiveness of entry level videoconferencing systems (see MPC 96-67 "Peer-to-Peer Desktop Videoconferencing, Phase I"). The systems were required to run on a Pentium 60 Mhz computer with 8 mb of RAM which was connected to the Internet. The Computer-Based Intelligent Technology Lab found, in 1996, that Intel Proshare offered the most functionality for the cost. Furthermore, these systems also were capable of ramping up to the next generation of conferencing technologies ranging from new audio codecs, video codecs, and new transmission topologies such as ISDN, which would become available to more of the remote regions in the next two or three years. Therefore two of the systems were installed, one at UDOT, the other at Utah State University, to test the versatility and usability of the systems of the Wide Area Network (Internet). The success of the first project catalyzed the next phase of the project to install eight more of the systems around the state of Utah and to test their capabilities when used in a larger network. Phase II of the project was aimed at resolving technical issues, installation, and the administration requirements to keep such a system in a coherent usable state.

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Peer-to-Peer Desktop Video Conferencing Final Report

Phase II

UT-98.04
Utah Department of Transportation

Mr. Thad E. Senti
Dr. William J. Grenney
Mr. Newell W. Crookston

Utah State University

(Phase I — MPC 96-67)

February 1998

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ABSTRACT

The Utah Department of Transportation (UDOT) recently investigatedthe cost and effectiveness of entry level video conferencing systems (see MPC 96-67 "Peer-to-Peer Desktop Video Conferencing, Phase I) . The systems were required to run on a Pentium 60 Mhz computer with 8 mb of RAM which was connected to the Internet. The Computer Based Intelligent Technology Lab found, in 1996, that Intel Proshare offered the most functionality for the cost. Furthermore, these systems also were capable of ramping up to the next generation of conferencing technologies ranging from new audio codecs, video codecs, and new transmission topologies such as ISDN, which would become available to more of the remote regions in the next two or three years. Therefore two of the systems were installed, one at UDOT, the other at Utah State University, to test the versatility and usability of the systems of the Wide Area Network (Internet). The success of the first project catalyzed the next phase of the project to install eight more of the systems around the state of Utah and to test their capabilities when used in a larger network. Phase II of the project was aimed at resolving technical issues, installation, and the administration requirements needed to keep such a system in a coherent usable state.

TABLE OF CONTENTS

INTRODUCTION

The Utah Department of Transportation (UDOT) recently installed two Intel Proshare desktop video conferencing systems (as part of Phase I : Peer-to-Peer Desktop Video Conferencing). The installations allowed personnel at the UDOT Complex and Utah State University to work on the same projects simultaneously, using the software to share ideas, conduct meetings, and exchange data. The Intel software and hardware were tested and it became clear that a larger installation would be a practical next step to formalizing a video conferencing network. Phase II of the project was designed to address the usability issues of the systems and clear up concerns regarding Proshare's effectiveness over the network to more remote regions where network bandwidth might not be as good.

As background data, the Intel Proshare systems allow the various UDOT Regions throughout Utah a cost effective means to communicate using video technology without the need for expensive transport protocols or topologies such as ISDN. The Intel Proshare systems are able to operate over existing LAN and WAN networks using standard TCP/IP protocols, as well as ISDN if needed. The systems were immediately available for use between each region, regardless of their access to ISDN, and were able to participate in a video conferencing session via the UDOT Wide Area Network. The cost, roughly $1,380.00 (cost for each sight for year 1996-1997), was also quite reasonable compared to other systems that offered comparatively less functionality.

In addition to these advantages, the individual region's "ownership" of the systems empowered them with the ability to freely schedule their own dates and time for meetings. One of the biggest complaints registered by users of the higher end systems, such as the telecommunications over the Utah Education Network (UEN), were scheduling problems. Although the higher end systems offer better visual clarity for large groups, the competition for use and the limited working hours in a day makes its use prohibitive for day-to-day informal meetings.

Due to the success of the first phase, the next step was to incorporate six additional sites around Utah so that more of the UDOT region offices could benefit from video conferencing and application sharing technology. These sites initially would be installed, tested, and optimized by the Computer Based Intelligent Technology Lab at Utah State University and then turned over to the authorized technical personnel at each of the regions to maintain and schedule for use as they deemed necessary.

PROJECT IMPLEMENTATION

The project involved the purchase of six additional Intel Proshare Systems for distribution among the various UDOT Regions and a total of eight sites. After some discussion, the committee selected Cedar City, Price, Richfield, Salt Lake City, the UDOT Complex, Ogden, and USU. One system each was be installed for Cedar City, Price, Ogden, Salt Lake City, Ogden, and Utah State University. Two systems were placed at the UDOT complex. These sites were targeted as the regions that would most benefit from this phase of the video conferencing installation.

The sights chosen for installation involved considerations such as personnel at each site with adequate technical knowledge for administration, the availability of a personal computer with the required computing power to support the Intel Proshare System, an available IP address for the Proshare system, and whether or not there was a high speed connection available for video conferencing to take place. With these criteria in mind, Mr. Newell W. Crookston, a technical expert, was selected to travel to each of the sights over a three-month period to install the Intel ProShare package at each of the sights. When each of the sights were implemented and running properly, the next phase of the project began conferencing sessions from each of the regions, and determined if the Wide Area Network was capable of supporting video conferencing sessions.

With respect to bandwidth, Phase I had tested this functionality between UDOT and USU and found the bandwidth to be sufficient. However, the bandwidth between the two stations generally was better than what was suspected would be available between each of the regions. As Intel Proshare allows for data transmission by way of either the Internet or ISDN lines it was felt the Internet should be thoroughly tested first, as it was the most cost effective transmission method available at the time. However, the Internet is a public channel, meaning that its access is open to many users at the same time, and thus is subject to bandwidth sharing problems. It was decided that if the conclusion of this test decided that the network was not sufficient for individual video conferencing sessions, the next phase of the project could explore the possibility of utilizing ISDN lines. Because ISDN limits use to only a small group, the sender and the receivers, the quality of the audio and video improves

substantially. ISDN is not effected by the level of traffic on the network as it is a private channel. Intel provides an ISDN board as part of its software conferencing package. To use it, ISDN lines must be obtained and a phone company notified. All the major phone companies provide this service. However, at the time of this implementation, ISDN only was available to the UDOT Complex and selected locations in the Salt Lake City area. Furthermore, once ordered, U.S. West predicted three to six months time before installation was complete. Thus the project continued implementation assuming the wide area network would be the only transmission medium available. Still, the C-BIT Lab installed each Intel Proshare site with full ISDN functionality realizing that this perhaps would be the future transmission topology for the systems.

PHASE II RESULTS

As Phase II primarily was an implementation phase, the majority of the research centered around how easy the systems were to implement, how the "marketed' requirements to run the system compared to what really was required to run a practical session, and how effective the system was over new wide area network connections.

A variety of computer systems have been and are in use as the base system for the Intel Proshare system. The lowest end system, a Dell Pentium 60, has provided adequate operation, but has been found to wane when used as an application sharing device. This can be attributed, however, to the natural obsolescence that occurs with computer systems, and the heavier requirements of new software. One of the more powerful system implementations is a Dell XPS 200 Mhz computer operating at the Computer Based Intelligent Technology Lab. As can be expected, this machine's performance is much improved over lower end systems. In other installations, a system that had only PCI slots was made available for setup. Intel Proshare, however, requires that two ISA slots be made available. One is used for the ISDN board, and the other is the video capture card. In another case, a fairly powerful system was provided, but this system did not support the Plug and Play bios. Although Intel Proshare can be installed on such a system, it increases the potential for Interrupt conflicts and resource errors. It is highly recommended that systems intended for use with Proshare qualify for the modern specifications for Windows 95 computers, and that the Intel Proshare requirements are reviewed before obtaining or purchasing a computer for use with Proshare.

As in the original project, different settings for imaging and sound were used in an attempt to find ones that provided the greatest quality. Some of this testing involved use of speakers rather than microphones, and placing the microphone on the table rather than having it attached to one person. With UEN teleconferencing as a comparison, tests found that for larger groups where a large screen is required the Proshare image and sound transmission continued to lack quality as it did for the original Phase I test. With respect to audio, a variety of non-video conferencing microphones and external speakers have been tried. It was confirmed that a more formal

setup would be required for audio, and is available from Intel and other vendors, when the Proshare system is used in a group fashion. With respect to video, when the monitor itself is used in a large group, it is highly unlikely that most individuals will see the remote sight from their position in the room. However, with the image projected on a large screen using an LCD plate or other scan converter system, the line-of-sight issue and visibility was resolved and considered a solution for group conferencing.

It should be reiterated that the Intel ProShare, being designed primarily for a one-on-one conference, includes a microphone system for that specific purpose. Because Intel has incorporated echo cancellation technology into its product, using this microphone for large groups with open speakers, i.e. not headphones, results in only half-duplex audio, which means that if the local sight is sending audio, they will not hear any audio being transmitted from the remote sight. The microphone system included with the ProShare product pipes the audio directly into the user's ear, effectively bypassing feedback problems where the audio might go back into the mic and be transmitted back to the sight that sent the audio. It is recommended that if users intend to use ProShare for room conferencing they should invest in "Push-To-Talk" audio systems whereby the mic is only open if an individual is speaking. Intel also offers full room conferencing systems that are based on the ProShare technology.

For a small group of people working together in remote locations throughout Utah, desktop conferencing with Intel ProShare serves its purpose extremely well. As for a continuous transmission, many problems have arisen with regard to halting in the video. Audio also failed on many attempts and became broken and choppy when network traffic was high. The CBIT Lab strongly recommends that ISDN be considered as the new transmission technology to be used for connecting each of the Proshare systems. Not only will this solve many of the video/audio quality issues, but also allow for multipoint video conferencing between the sites, and will open the regions up to the State of Utah's video conferencing network initiative. Furthermore, each of the regions will be able to reach anyone in the world with a video conferencing system using ISDN.

The data transmission for application sharing from one monitor continued to occur with accuracy and precision, although a Pentium computer of at least 100 MHz would provide for better response. As described

more clearly in the new minimum requirement offered by the CBIT lab, the requirement by Intel (a 486 66 Mhz) made the application sharing far too sluggish during heavy activity.

NEW SYSTEM REQUIREMENTS SUGGESTED BY THE CBIT LAB

As compared to Phase I, it was found that to install an Intel ProShare desktop conferencing package, a substantially higher capacity computer was required to run the system practically. Although the Proshare system will run under the old specification, the CBIT Lab discovered that for quality application sharing to take place while audio and video are broadcast, the purchase of a computer with the following specifications is recommended (old specification is normal, new specification is in bold). Regardless if application sharing is used, the new requirements will allow for more diverse video conferencing and can take advantage of new upgrades in the Proshare software:

- **Pentium or Pentium II microprocessor with 100 MHz processing speed minimum.**
- **Mixed ISA and PCI slot system. Proshare requires two ISA slots for operation. We suggest the video card be either PCI, or the new AGP standard.**
- **16 MB of RAM, 32 MB preferred.**
- 486 microprocessor with 66 MHz processing speed minimum, 586 (Pentium) 60 MHz or better preferred.
- Microsoft Windows 95 with full network support and access to the Internet;
- **17-inch monitor minimum. 21-inch monitor preferred.**
- 15- to 17-inch monitor. The larger the better, as you can do more on the screen with white-boards and application sharing while still viewing one or more conference windows.
- **A high color (16 million color) accelerated PCI or AGP graphics card.**
- A video board that supports 256 colors or more. No less than 256 color support will do, as the color degradation of 16 color systems makes video conference intolerable if not impossible.
- For ISDN use : ISDN telephone service from local phone company including NT-1 adapter
- For LAN/WAN user: Network interface card with IPX, TCP/IP, or NetBIOS protocol support

The recommended software package is the latest version of Intel ProShare (at Version 2.0 as of this writing). This package provides everything needed for desktop conferencing: an ISDN board, sound board, video capture ability, a video camera, and a combination microphone and earphone. If conferencing is to occur using the Internet, the user must install a network board and have direct access to it. The cost of the Intel ProShare package averages $1,300 for businesses. Price reductions are available for users who purchase ISDN, as well.

CONCLUSION

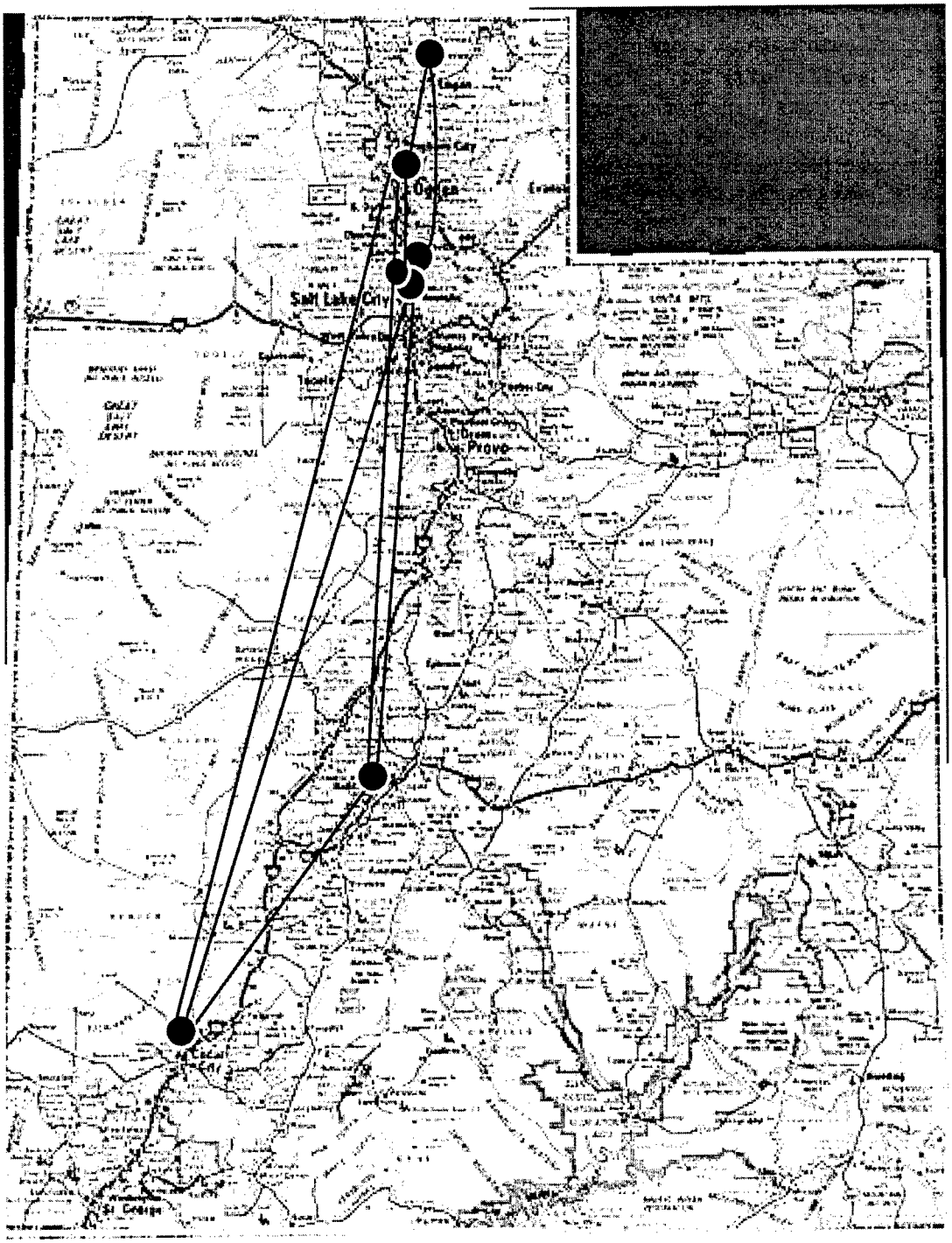
After testing, it was concluded that Intel ProShare continues to work effectively for one-to-one conferencing, and therefore, as a suitable low-end alternative to UEN for certain applications.

As each new region was brought on board, a great deal of enthusiasm surrounded the new technology. The 1997 year has been considered a successful implementation phase for the new proshare systems. Many of the regions have used the Proshare systems regularly to reduce travel costs to and from the UDOT Complex.

Most importantly, however, the installation of the systems were inherently valuable to the regions and people involved. It gave each region an opportunity to experiment among themselves, organize meetings, and exchange data via the Proshare system, while having the CBIT lab available to provide technical knowledge, as well as get them started by installing the systems. It also afforded the technical personnel at each region exposure to this technology, let them "tweak" systems on their own for better performance, and gain a better understanding of the requirements and uses of desktop video conferencing systems. Perhaps most important of all, the installation of the systems has nicely prepared each region and the technical people at the locations for Utah's State Video Conferencing network, which will be completed in 1998-99. The topology of choice will be ISDN using Picturetel systems. Intel Proshare has been proven to integrate nicely into the systems.

APPENDIX A:

CBIT LAB & UDOT PROSHARE VIDEO CONFERNCING NETWORK SITE MAP



APPENDIX B:

GLOSSARY OF USEFUL TERMS

Additional Primary Directory Number

If more than two terminals are connected to a digital subscriber loop, additional primary directory numbers are required. Included with each primary directory number is the standard set of voice and data features. Rates and charges are specified in the individual state offering and apply to each additional primary directory number.

Analog Call Appearance

This feature enables analog station users to share call appearance on a Single Line ISDN Services user's terminal. The user's analog service must be provisioned from the same serving central office as the Single Line Service. One appearance, per number, per terminal is allowed. Some analog services are not compatible with Single Line ISDN Service.

CALC

Customer Access Line Charge (CALC). In the FCC tariff it is referred to as End User Common Line (EUCL) Charge. It also is referred to sometimes as Subscriber Line Charge (SLC).

FCC Rules (69.104) EUCL defines as follows:

A charge that is expressed in dollars and cents per line per month shall be assessed upon end users that subscribe to local exchange telephone service, Centrex or semi-public coin telephone service to the extent they do not pay carrier common line charges. Such charge EUCL shall be assessed for each line between the premises of an end user and a Class 5 office that is or may be used for local exchange service transmissions. Each Single Line Service is charged one CALC or EUCL. The amount varies by state.

Call Exclusion

This feature has two options:

- Automatic Exclusion

  This option allows a user to restrict other users that share a Directory Number from bridging to an active or retrieving a held call. This option automatically is invoked whenever the user goes off-hook to receive or place a call.

- Manual Exclusion

  This option allows a user to restrict other users that share a Directory Number from bridging to an active call or retrieving a held call. This option is activated by pressing a feature button before dialing or during the call.

Call Forwarding Busy Line-All Calls

This feature allows all calls to a busy Primary Directory Number to be forwarded to another number either in the same central office, for the same customer at the same location, outside the customer system in the same central office, or in a different central office.

Call Forwarding-Don't Answer

This feature allows all calls terminating to an idle Primary Directory Number to be forwarded to another number when the called Primary Directory Number does not answer after a predetermined number of seconds.

Call Forwarding Variable-All Calls

The user can forward all Primary Directory Number calls to another number by pressing the Call Forwarding-Variable feature button. The user must activate or deactivate the forwarding function by using either an access code or a feature button. The standard configuration provides for this feature button.

Call Forwarding Busy Line For Circuit-Switched Data

This feature permits all circuit-switched data calls, attempting to terminate to a busy primary directory number, to be redirected to another customer-specific directory number. A busy line condition exists when a circuit-switched data B-channel is available. This feature can be assigned either to the user on an active basis or it can be assigned to a feature button activated or deactivated by the user. If the feature is assigned to a feature button, the forward-to directory number can be changed by dialing an access code and programming the new forward-to directory number.

Call Forwarding Don't Answer For Circuit-Switched Data

This feature permits all circuit-switched data calls attempting to terminate to an idle primary directory number to ring a specified number of seconds prior to being forwarded to a previously specified directory number. This feature can be assigned either to the user on an active basis or it can be assigned to a feature button activated or deactivated by the user. If the feature is assigned to a feature button, the forward-to directory number can be changed by dialing an access code and programming the new forward-to number directory number.

Call Forwarding Variable-All Calls For Circuit-Switched Data

This feature allows circuit-switched data calls attempting to terminate to a line, redirection to another specified line. The user must activate or deactivate the forwarding function either by using an access code or a feature button. If the feature is assigned to a feature button, the forward-to directory number can be changed by dialing an access code and programming the new forward-to directory number.

Call Hold

This feature allows the user to place a call on hold by depressing a button.

Call Pickup

This feature allows a user to answer a call at another station, even when the user's station does not have a call appearance for the called directory number. While the other station is ringing, the user goes off-hook and enters a call pickup code or presses a call pickup feature button to answer the call.

Call Rejection

This feature enables a customer to reject call attempts from up to 15 numbers of calling parties by dialing a code and the telephone numbers of calls to be rejected. Any call attempts to the customer from these numbers will be prevented from terminating to the customer and will instead be connected to an announcement informing the caller that the call is not presently being accepted by the called party.

Call Transfer

This feature enables the user to transfer a call to a third party by depressing a button.

Caller Identification Blocking - All Calls

This feature provides a permanent private indicator on a per station basis. Once the blocking is established on the station, the private status cannot be deactivated by the customer. Federal, state and local law enforcement agencies and non-profit domestic violence agencies may be provided additional arrangements for private status and all call blocking, on a per station basis, at no charge. Stations that share appearances of a restricted station also must be restricted to avoid passing caller identification information.

Caller Identification Blocking - Per Call

This feature enables a customer to control the disclosure of their name and Directory Number to a subscriber of Caller Identification, where technically feasible, by temporarily changing the public/private status indicator of the Directory Number. A customer must dial a code before each call to change the indicator from public to private. "Public status" allows delivery of the name and/or Directory Number. "Private status" prevents delivery of the name and/or Directory Number. Per Call Blocking is provided at no charge.

Calling Line Identification

Calling Line Identification is provided on an incoming and outgoing basis.

- Incoming

  Calling Line Identification is provided on an incoming and outgoing basis. This feature displays the call identification information and the calling party's Directory Number, including nonpublished and nonlisted directory numbers, prior to the call being answered. Calling party's name is not available. Callers have the ability to inhibit the display of calling party information to the terminating number. Incoming calling identification is provided to the Primary Directory Number and to any associated Secondary Directory Number. Incoming calling line identification cannot just display to the Primary Directory Number when the number is shared.

- Outgoing

  This feature provides a user originating a call with information about the called party and the facility or destination.

Conference

This feature allows a user to establish a three-way conference call by depressing a button.

Continuous Redial

This feature allows a customer to dial a code that will cause the feature to automatically redial the last number the customer dialed. If the called number is busy, the feature will redial the called number for a limited period of time. A tone alerts the customer when the called number becomes available.

Digital Subscriber Loop

The ISDN basic rate interface loop from the central office to the customer's premises.

DID/DOD

Direct Inward Dial/Direct Outward Dial. Special trunks in trunking network. As the name implies, direct inward provides for direct inward dialing and direct outward provides for direct outward dialing.

This allows station users to place or receive calls by-passing the attendant.

Display

This feature provides the ISDN terminal a display of the time and date, calling number, call appearance identification, called number, incoming call identifier and feature activation operation.

Drop

The Drop button allows the user to drop the last party added to a conference call or disconnect a two-party call.

Hunting

Hunting is available for circuit-switched data on primary directory numbers.

Hunting Service will affect the operation or availability of some other optional features on the hunting B channel. The features most often affected include forms of Call Forwarding, Speed Calling, and others, depending on the Service Configuration. Call Forwarding features will override the Hunting Services.

Hunting is done sequentially by terminal in the group. One or two B channels are associated with each terminal in the group. One begin-hunt telephone number must be assigned to the first terminal in a regular or circular group of sequentially-ordered terminals that form a multiline hunt group. Telephone numbers may be assigned, in any sequence, to terminals in a multiline hunt group

Multiline Hunt Service provides a hunting sequence that attempts to complete a call to the first available B channel associated with the lead telephone number of the group. Busy tone is not sent to the caller unless all remaining B channels in the hunt group list have been busy. The call will be completed to the first available B channel.

Multiline hunt groups can be assigned two types of telephone numbers — begin hunt and non-hunting telephone numbers. The begin hunt telephone number has the multiline hunt feature and, when called, starts the hunting sequence associated with the hunt group. A multiline hunt group must have at least one begin hunt telephone number but can have essentially one per terminal in the group. Non-hunting telephone numbers can be assigned to terminals in a multiline hunt group; the terminals do not have multiline hunt feature. Incoming calls are terminated directly to the individual terminals.

Regular hunting starts when a begin hunt telephone number is called in a multiline hunt group. Hunting proceeds in ascending order through each subsequent terminal in the group until an idle terminal is reached or the last (highest numbered) terminal in the group is reached.

Circular hunting is provided optionally with regular hunting groups. Circular hunting occurs in the groups when the hunt for an idle terminal commences beyond the first terminal in the hunt group and finds all higher numbered terminals busy, the hunt returns to the first terminal in the group. The hunt ends with the terminal number preceding the terminal where the hunt in the group initially began.

This feature allows all terminals in a multiline hunt group to be tested for busy regardless of the point of entry in the group before returning busy tone.

Uniform call distribution is a hunting arrangement that provides uniform termination call assignment (distribution) to members of a multiline hunt group. Uniform call distribution does not include queuing or announcements.

Intra Wire Center

A wire center is the physical wires or facilities that extend from a central point and fan out in a tree-like manner into the serving areas — homes, businesses, etc. Intra wire center is in this network.

Intercom

Intercom service allows the user to establish a dedicated priority call to any other station that is a member of the same intercom group in the same central office. Special alerting, depending on customer premises equipment is provided for an incoming intercom call. As part of the standard package the user can select either Auto Intercom or Dial Intercom.

Auto Intercom

This feature allows two members to be part of an intercom group, which enables intercom calls to be completed by pressing the feature button. Dialed digits are not required.

Dial Intercom

This feature allows the user to establish a call to any other station that is a member of the same intercom group. This is done by pressing the Intercom button and dialing one or more digits. Special alerting, depending on customer premises equipment, is provided for an incoming Intercom call.

Integrated Services Digital Network (ISDN)

ISDN stands for "Integrated Services Digital Network." It is a digital architecture that provides an integrated voice/data capability to the customer premises facility, utilizing the public switched network. ISDN distributes voice, data, video, image and facsimile by two standard methods of access: a Basic Rate Service (BRS) or a Primary Rate Service (PRS). These are serving arrangements that conform to internationally-developed, published and recognized standards generated by the International Telecommunications Union.

Basic Rate Service consists of up to three distinct channels on one pair of wires: one or two B (Bearer) Channels and one D (Delta) Channel. BRS is offered in a package offering referred to as U S WEST Single Line Service.

The B channel carries circuit-switched voice and/or data communications at speeds up to 64 Kbps, from the customer's premises, over the loop facility to the central office.

Circuit switched data provides the capability of making data calls over the public switched network. Information is transmitted the same way as digitized voice. Like a voice call, a circuit switched data call ties up the network/system resources for the duration of the call. Similar to voice, Calling Line Identification is provided.

The D channel carries signaling and/or packet data information, at speeds up to 16 Kbps on BRS and signaling only information up to 64 Kbps for PRS, from the customer's premises to the central office. The D channel has data and signaling functionality; it does not have voice capability.

PRS has a capacity of 1.544 megabits per second and has multiple channels: 23 B channels and one D channel and also is known as 23B + D access. The B channels carry voice calls, circuit switched data, and video, while the D channel handles signaling information.

Inter Wire Center

A wire center is the physical wires or facilities that extend from a central point and fan out in a tree-like manner into the serving areas — homes, businesses, etc. Inter wire center is in this network.

Kbps

Transmission speeds are most accurately measured in bits per second, or bps. Commonly used abbreviations are:

- Kbps
- Mbps
- Gbps
- Kilobits per second
- Megabits per second
- Gigabits per second

- Thousand bits per second
- Million bits per second
- Billion bits per second

The term bit is a contraction of binary digit, the smallest unit of digital information, either an on or off signal. The term byte is similar, but actually represents one full character — a letter, number or symbol — of seven or eight bits, depending on the computer code used. The term is an older analog designation and refers to the number of times per second the sine wave of an analog voice line can be successfully modified.

Although the terms bit, byte and baud are frequently interchanged, they are not the same. Speeds on the pages consistently are referenced in bits — kilobits, megabits and gigabits per second.

Last Call Return

This feature allows a customer to automatically redial the number of the last incoming call to that line, whether the call was answered or not. The customer does not have to know the number of the calling party. If the called number is busy, the feature will redial the called number for a limited period of time. A tone alerts the customer when the called line is available.

Loop Qualifications Requirements

U. S. WEST Single Line Service is offered where ISDN compatible facilities and equipment are available. Service generally is considered available for loops 18,000 feet or less in length. Loops greater than 18,000 feet must meet ISDN extension technology design requirements and will be considered available if ISDN compatible pair gain systems are in place or planned to serve the area based on scheduled placement of compatible pair gain systems. If no pair gain system is in place or planned, loops greater than 18,000 feet in length also will be considered available if single line loop extension equipment can be deployed and the loop is in the design limitation of this type of extension equipment. There will be cases where it will be impossible to provide Single Line ISDN Service to a location immediately due to the inherent restrictions that must be met as part of the ISDN design requirements. In other words, because of the nature of the existing loop network some customers may not receive service.

One of the first steps in the ordering process is to determine whether or not the local loop or the facility between the central office and the customer premises meets the design criteria for an ISDN loop. When special action is required, the order interval may have to be lengthened to provide the service.

Mbps

Transmission speeds are most accurately measured in bits per second, or bps. Commonly used abbreviations are:

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- Million bits per second
- Billion bits per second

The term bit is a contraction of binary digit, the smallest unit of digital information — either an on or off signal. The term byte is similar, but actually represents one full character — a letter, number or symbol — of seven or eight bits, depending on the computer code used. The term is an older analog designation, and refers to the number of times per second the sine wave of an analog voice line can be successfully modified.

Although the terms bit, byte and baud are frequently interchanged, they are not the same. Speeds on these pages are consistently referenced in bits — kilobits, megabits and gigabits per second.

Measured Service (Usage)

In addition to the regular monthly charge for access to the local and toll network, local usage charges apply for outgoing calls completed on a local basis. The rates for usage vary by state and may be based on one or more of the following: the number of local messages, the duration of holding time of each message, the distance between calling and called numbers, and the time of day the call is made. Chargeable time begins when connection is established between the calling station and the called station. Chargeable time ends when the calling station hangs up, thereby releasing the network connections. If the called station hangs up, but the calling station does not, chargeable time ends when the network connection is released by automatic timing equipment in the telephone network.

Message Waiting Indication

This feature is available on Primary Directory Number's and notifies the user of a message waiting by providing either an audible stuttered dial tone or visually by illuminating a light on the customer's telephone set. Messages may be retrieved by calling the message service center or by accessing a voice mail system.

National ISDN - National Integrated Services Digital Network

Beginning in 1992, telephone companies like U. S. WEST and network switching system manufacturers, committed to provide standard ISDN services. This commitment is called National ISDN. National ISDN specifies the way that telephones and computers, Customer Premises Equipment (CPE), communicate with the ISDN network. The National ISDN agreements ensure that each central office switch operates in a standard way, providing a uniform interface to CPE. With National ISDN conformance, a phone (for example) will work on any type of National ISDN switch and will interwork with the analog public switched network.

For some customers without National ISDN, such as those who began using ISDN before 1993, there can be some minor variations in the service they receive depending on the brand of central office switch that provides service. The variations can effect CPE configurations, but generally the customers can place ISDN calls to other ISDN customers, as well as to analog phones.

Stated a little differently, it is a set of standards defined in technical documents written by Bellcore in agreement among telephone companies, switch manufactures, and Customer Premises Equipment (CPE) vendors. This agreement allows consumer provided equipment to work across different telephone company switches using the Basic and Primary Rate Interfaces. CPE is the equipment after the point at which the telephone company terminates the line to the premises. This includes the Network Termination -1 (NT-1) device.

Non-Standard Configuration Group

This is a terminal arrangement, associating buttons of a terminal with a feature, which differs from the standard arrangement.

Packet Switch Network

Packet switching is a data transmission technique whereby user information is segmented and routed in discrete data envelopes called packets, each with its own appended control information for routing, sequencing, and error checking; allows a communication channel to be shared by many users, each using the circuit only for the time required to transmit a single packet. Packets are sent using a store-and-forward method across nodes in a network. Packet switching network then is a network that operates in this manner. A common use for this technology in the ISDN environment is for point of sale or credit card validation.

Packet Switching Usage Charges

Packet transport provides for the routing of data through the public packet switched network in the originating and terminating directions. Use charges are billed monthly based on the number of kilosegments transmitted through the public packet switched network for all types of access and is rated on a per kilosegment basis. A segment consists of 64 octets of customer data. For example, a packet of 128 octets will be billed as 2 segments.

The Packet Usage rate provides a rate for day usage, 6 a.m. - 6 p.m., and a lower rate for night usage, after 6 p.m. and before 6 a.m., as measured at the Signaling Network Control Center, Denver, CO. The rate period in effect when the packet segment originated will apply.

Packet Usage will be rounded up to the next whole kilosegment in the billing period. Day and night usage will not be combined. A call overlapping from Day Usage to Night Usage or vice versa will be billed at the appropriate rate for the time period.

PBX

Private Branch eXchange. Telephone switching equipment dedicated to one customer and connected to the public switched telephone network.

Primary Directory Number

Each ISDN terminal is assigned one Primary Directory Number. If more than two terminals are attached to a digital subscriber loop, an additional Primary Directory Number charge will apply.

Priority Call

This feature allows a customer to assign a maximum of 15 callers' telephone numbers to a special list. The customer will hear a distinctive ring at their location, when calls are received from callers' telephone numbers on that list. The distinctive ring may be customer premises equipment.

Public Switched Telephone Network

The telephone network, called the Public Switched Telephone Network, is based on the principle of providing two-wire analog circuits for voice transmission. The most common phone line, such as the one in your home, is the dial-up line, or switched circuit, which uses two wires to connect your phone jack to the phone network. Inside of the PSTN, you will find lots of digital gear. But at your home prior to Integrated Services Digital Network, it was all analog. Integrated Services Digital Network provides the capability for end-to-end digital connectivity.

Rate Stabilized Contract

This plan is for customers who are willing to commit to a specific number of ISDN Single Line Service lines over an extended period. Because of this commitment the customer enjoys a discount and stable price.

Ringing Options

Ringing options allow ISDN station users to establish flexible call handling arrangements for answering incoming calls that terminate on the shared call appearances of a directory number. The ringing options available on a per station basis for a shared directory number are:

Abbreviated Ringing

Ringing begins immediately for an incoming call and stops ringing after a number of seconds.

Delayed Ringing

Ringing for an incoming call is delayed for a number of seconds, however, the call appearance indicator or "status" lamp begins flashing immediately.

No Ringing

There is no ringing for an incoming call that terminates on a call appearance of that directory number.

Normal Ringing

Ringing begins immediately for an incoming call and continues until the call is forwarded, answered, or abandoned.

Second Directory Number

A second directory number is any directory number other than the primary directory number assigned to an ISDN terminal. If more than one secondary directory number is assigned to a terminal, additional charges will apply.

Selective Call Forwarding

This feature allows a customer to specify a special list of a maximum of 15 telephone numbers. Incoming calls placed to the customer from telephone numbers on that list automatically will be forwarded to a predefined telephone number. All other calls will be handled normally.

Shared Call Appearance

This allows several users to share one or more call appearances for a particular directory number. Origination of and termination of calls on one terminal will affect all terminals sharing the call appearance. All secondary call appearances must be provisioned from the same serving central office. If more than two secondary call appearances are assigned to a terminal, additional charges will apply.

Single Line ISDN Service

Single Line ISDN Service (SLS) is a platform-based switched digital service offering fast, flexible, highly reliable, and digitally-clear connections with the simplicity of dialing a telephone. Based on international communications standards, ISDN provides users access to the powerful capabilities of today's Public Telephone Network for communicating across town, or around the world. With Single Line ISDN Service, the same pair of wires that now delivers one communication at-a-time basic phone service to business or residence customers provides two primary, high speed (64 Kbps) communications channels that can be used simultaneously and independently to carry any combination of data, image, video, or voice calls. By combining the channels, data transfer at up to 128 Kbps may be achieved. Single Line ISDN Service also provides a third, auxiliary channel for low to moderate speed data communications, which is ideal for point of sale, remote monitoring or telemetry applications.

No special handling is required when voice calls are made between ISDN phones and conventional telephones — the network manages the necessary conversions. When conducting data calls to use the B Channels for digital communications, ISDN based equipment is required at both ends of the communication path; as is the case with conventional modem connections or fax machine transmissions. Certain ISDN equipment also allows for modem-to-modem communications, providing the ISDN subscriber the best of both worlds!

Single Line ISDN Service is the U S WEST name for Basic Rate Service. Single Line ISDN Service includes a comprehensive 2B + D package. Contained in the standard package are numerous voice and data features. The standard features and functions support two terminals per basic rate service. In the standard package there is limited flexibility for customization and various optional features can be added. Single Line ISDN Service does not offer B channel packet service capability.

Six Call Appearances

Call Appearances are the positions on a terminal to which directory numbers are assigned. A Primary Directory Number (PDN) can be shared by more than one ISDN terminal. The quantity and position of PDNs, Secondary Directory Numbers (ISDN) Analog Call Appearance (ACA) and Shared Call Appearances are limited by the standard configuration developed for the Customer Premises Equipment. The standard package has six call appearances.

The six call appearances will include one Primary Directory Number and five call appearances, on consecutive buttons, made up of the following:

- Maximum of five call appearances of the Primary Directory Number
- Maximum of one Secondary Director Number
- Maximum of four call appearances of the Secondary Directory Number

- Maximum of one Analog Call Appearance
- Maximum of two shared Directory Numbers

Intercom call appearances do not count against the standard.

Six-Way Conference

This feature allows the user to sequentially add up to five additional parties, and add them together to make a six-way call.

64CCC

U. S. WEST offers 64 Kbps Unrestricted (transport of voice and data - rated adapted up to 64 Kbps) Clear Channel Capability (64CCC) data connectivity. Customers will be connected to an ISDN interoffice communication using the Common Channel Signaling - Signaling System 7 Network in accordance with Bellcore Technical Reference TR-NWT-000444.

64k Clear Channel Capability

U. S. WEST offers 64 Kbps Unrestricted (transport of voice and data - rated adapted up to 64 Kbps) Clear Channel Capability (64CCC) data connectivity. Customers will be connected to an ISDN interoffice communication using the Common Channel Signaling - Signaling System 7 Network in accordance with Bellcore Technical Reference TR-NWT-000444.

Speed Calling

Speed calling permits the user to dial pre-programmed numbers using fewer digits than normally required. A speed call list allows for up to 30 preprogrammed numbers per terminal.

Speed Calling 8

This feature permits the user to dial pre-programmed numbers using fewer digits than normally required. It allows the customer to change speed calling lists directly from their terminal.

Standard Configuration Group

The standard arrangement which associates a button of an ISDN station to a feature.

T1 Facility

This element is the digital facility transmitting at a rate of 1.544 Mbps. The T1 signal provided to the customer's premises will have a loss not greater than 16.5 dB. The T1 facility may be provided, at the customers request, via fiber optic facility between the U. S. WEST central office and the customer's premises.

Transaction Initiation Charge

A transaction initiation charge is defined as any action taken that leads to a call of acceptance by the called party. A transaction initiation charge will apply for each originating or terminating call connected to a network address. This charge does not apply for unsuccessful call attempts.

23B+D

PRS has a capacity of 1.544 megabits per second and has multiple channels: 23 B channels and one D channel and also is known as 23B + D access. The B channels carry voice calls, circuit switched data, and video, while the D channel handles signaling information.

U. S. WEST Centrex Plus Service

Centrex Plus is a family name for business communications systems furnished from U S WEST Stored Program Control central offices, analog and digital. It is offered with the intention of grandparenting all previous Centron and Centrex services. Centrex Plus does require special central office equipment and consequently is offered subject to the availability of facilities and applicable generic feature programs as determined by U. S. WEST.

A Centrex Plus system is defined by dedicated central office software called a common block. The common block identifies dialing patterns, code access dialing plans, restrictions and system and station features, much of which can be changed through software programming changes administered by the telephone company or by the customer using their Centrex Management System.

The common block is connected to the customer's premises by station lines. Station lines may be terminated at one location or combined from different locations so long as they all originate in the same central office. They are used by the Centrex Plus customer to place and receive calls, to access special facilities and to access/activate special features. In general, outgoing calls are placed by first dialing "9". Centrex Plus offers customers a wide variety of standard and optional features, allowing their systems to be tailored to meet specific and unique requirements.

Usage Allowance

The tariffs for Single Line ISDN Service include an option with an outgoing call usage allowance. This allowance includes up to 200 hours per month of aggregate usage for B channel circuit-switched voice and circuit-switched data. Additional usage in excess of the 200 hours in a monthly billing period will incur usage charges as specified in the individual state Basic Local Exchange Tariff.

Usage Charge

In addition to the regular monthly charge for access to the local and toll network, local usage charges apply for outgoing calls completed on a local basis. The rates for usage vary by state and may be based on one or more of the following: the number of local messages, the duration (holding time) of each message, the distance between calling and called numbers, and the time of day the call is made. Chargeable time begins when connection is established between the calling station and the called station. Chargeable time ends when the calling station hangs up, thereby releasing the network connections. If the called station hangs up, but the calling station does not, chargeable time ends when the network connection is released by automatic timing equipment in the telephone network.

X.25 Fast Select

Fast Select is a function of the customer premises equipment and is used on a per call basis allowing the user to send up to 128 octets in the user data field of the call request packet to a terminal with Fast Select Acceptance.

X.25 Fast Select Acceptance

This packet feature authorizes incoming packets from a sending data terminal equipped with Fast Select.

X.25 Flow Control Parameter Negotiation

This packet feature permits negotiation on a per-call basis of the flow control parameters associated with a given virtual call, such as packet size and window size for each direction of data transfer. The data window size and the maximum packet size is negotiated automatically during an X.25 data call.

X.25 Logical Channels

Virtual circuits rather than physical circuits are used to establish packet switch calls. When a virtual circuit is established, a logical channel is assigned at the customer premises equipment and the switch for the duration of the call. A virtual circuit does not use any capacity of the facility unless data is actually being transferred. Two logical channels are provided per digital subscriber loop.

X.25 Reverse Charging

This packet feature allows a user to assign billing to the called data telephone number on a per call basis.

X.25 Reverse Charging Acceptance

This packet feature authorizes transmission of incoming calls identified as Reverse Charge calls.

X.25 Throughput Class Negotiation

This packet feature permits negotiation on a per call basis of the throughput class for each direction of data transfer associated with a virtual call. The data terminal can negotiate the throughput class for X.25 data call.

X.75 Gateway

Packet switching networks use protocols that are internationally sanctioned by the International Telecommunications Union. The two prime protocols are X.25 and X.75. For a packet switching ISDN user to transmit data outside their serving central office, an X.75' link must be available between the serving office and a packet switching network. A user wishing to send packet switching traffic InterLATA must do so via a packet switching interexchange carrier. This link is referred to as an X.75' gateway.