Route-24™
Application Notes

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I. Executive Summary

Telco Systems' Route-24™ is an intelligent T1 access multiplexer that benefits T1 users by offering them flexibility, network simplification, and cost savings. It is cost-efficient and easy-to-use, so that network designers and communications planners can bring T1 access and intelligent system management tools into their telecommunications environment for those users with service requirements of up to 24 DS-0 channels. When used with MuxView Network Management System, a user can conveniently control the network from a desktop terminal or computer.

Flexibility

The key to flexibility is the intelligent network management approach. You can configure Route-24 to transmit any combination of T1 voice, data, or compressed video. These transmissions can occur at times which are most convenient and cost-effective for you. Instead of waiting for the installation of separate lines to accommodate specific transmission requirements, once you access your T1 network, you can easily reconfigure Route-24 to handle different types of transmission.

To take full advantage of Route-24, you will need Route-24 at each location where you want to access and control T1 service. Route-24 has specialized in multifunction voice and data interfaces to cover almost any application, such as 4W E&M, 2W FXO, 2W FXS, 56/64 Kb/s x N, and subrate data. From Route-24, you can go out over one T1 line to a public network. Using MuxView, you should be able to alter your T1 transmission mix whenever you need to take advantage of special transmission needs and rate economies.

You can configure the intelligent cards on Route-24 to handle voice, data, or compressed video using MuxView, a network management software program. MuxView displays choices available at any point in the program through simple menus or "windows". MuxView guides you through the quick set-up of each channel card. You can change the card parameters any time to accommodate special usage (like a video conference or batch data transmission, for example), or to take advantage of special rates offered by your T1 carrier.

Network Simplification

Route-24 lets you combine multiple voice and data channels over a single high-speed digital circuit. This makes it possible to control and maintain your network management resources from one central location. Instead of a collection of many lines, each dedicated to one type of transmission, Route-24 makes it possible to use the same leased line to transmit compressed video for teleconferencing, facsimile, and wideband or high-fidelity audio, in addition to normal voice and data signals. All of these can go through one T1 pipeline. By reducing the number of monitored circuits, your network becomes much more manageable.

Even though T1 tends to consolidate equipment, there will still be a variety of vendors involved in your T1 network. Centralized control of your T1 multiplexer, using equipment at your site, is cost-effective because it simplifies diagnostic monitoring and repair.

Cost Savings

A T1 network can be very cost-effective for you. An investment in T1 can break even in the first fiscal year. Yearly reductions in phone bills at an end user's company can reach millions of dollars. This is especially true with today's T1 networks, which allow you to use:

- Data Transmission: One 9.6-kb/s modem occupies a full analog line, or 4% of 24 voice channels, but it occupies less than 1% of a T1 line. In the typical 24-channel bandwidth, it is possible to transport at least 120 data channels.

- Subrate Data Multiplexing: Allows you to put multiple data channels in one DS-0 time slot.

- Switched 56: Dial-up, end-to-end, digital 56-kb/s circuit switching. Use only as you need it, for bulk data file transfer, video transmission, high-speed facsimile, CAD/CAM, image transfer, on-line file search, super-computer access, and more.

- Voice Compression: The number of voice channels on one T1 line can be increased to 44, or 48 with robbed bit signalling without affecting voice quality using voice compression techniques. This can represent a significant savings over the use of separate analog leased lines.

II. User Overview

The diagrams in this section show how you can quickly and cost-effectively set up your application using Route-24 in your T1 network. All of the components shown in each application can be mixed and matched to create the best network for your particular situation. Because many of the services and transmission types are shared among the T1 applications, you will see that they are repeated.

Definitions

Bandwidth A set of frequencies, grouped so that there is an upper and lower limit to the frequencies available for use. Best thought of as a pipeline through which transmission can occur.

DACS Digital Cross-Connect System. Can be programmed to route calls to a specific location. It is often used to group voice or data calls together-grooming-then send them over one T1 line to the other location. Can be used by carriers or by subscribers.

DDI-24 Telco Systems' DDI-24 Digital Drop and Insert System lets you drop off voice, data, and compressed video signals at various locations. The rest of the T1 signal continues to its final destination.

Dial-up 56K Dial-up, end-to-end, digital 56-kb/s circuit switching using AT&T's ACCUNET Switched 56 service or US SPRINT's VPN 56 service. Use it only as you need it. Switched 56 can be used for bulk data file transfer, CAD/CAM, video transmission, high-speed facsimile, image transfer, on-line file search and supercomputer access.

DSU Data Service Unit. Converts unipolar digital signals into bipolar signals for transmission onto the digital network.

Host CPU The main computer in your computer system, whether it is microcomputer, minicomputer, or mainframe. CPU stands for the Central Processing Unit.

Modem MOdulator/DEModulator. Converts a digital signal produced by a computer or terminal into an analog tone for transmission over analog phone lines.

N x 56/64K To accommodate high-speed batch transmission or large CAD/CAM files you can send data in multiples of 56 or 64K using Route-24.

PBX Private Branch Exchange. A private telephone exchange provides for the transmission of calls to and from the public telephone network.

Route-24 and MuxView Route-24 is an intelligent T1 multiplexer which can be configured for any combination of voice, data or compressed video. The intelligent cards on Route-24 can be set locally or remotely using MuxView, Telco Systems' T1 network management program.

Status 56 Status 56 Office Channel Unit (VPN 56), which, unlike traditional switched 56 services, gives you information about the call in progress. If there is no answer, the line is busy, or the connection is made, you will know.

Subrate Subrate data multiplexing (SRDM). Enables multiple, low-speed, synchronous and asynchronous channels per one DS-0 channel. Consists of 5 channels of 9.6 kb/s each, or the mathematical equivalent (10 channels at 4.8 kb/s, or 20 channels at 2.4 kb/s).

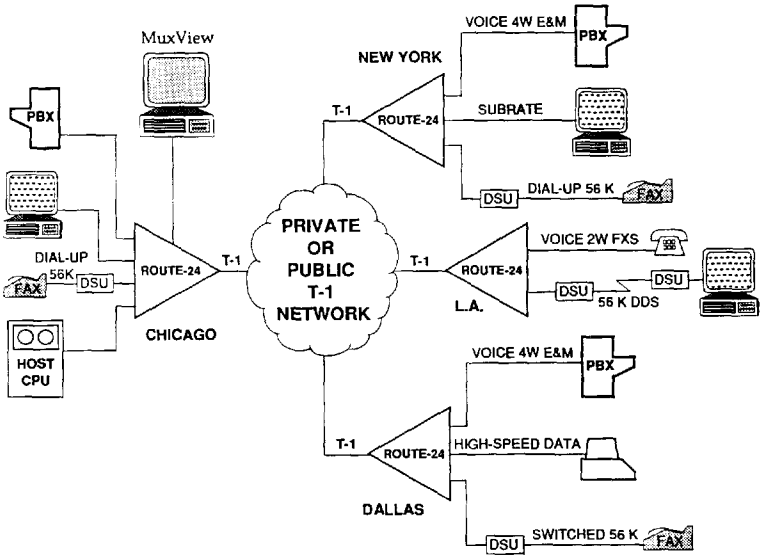
Voice 2W FXS 2-wire foreign exchange service. A dedicated line to a distant central office exchange. Usage is billed as a local central office call.

Voice 4W E&M Voice 4-wire Ear and Mouth. A method of trunk signaling; that is, signaling between a central office (CO) or PBX switches. Allows for simultaneous 2-way signaling between offices. The 4 wires allow a separation between the transmit and receive path for better transmission performance.

WATS Wide Area Telephone Service. You can use this service to install a dedicated line between one location and another location, using the public network. The line is usually dedicated to either incoming or outgoing calls.

4ESS Switch One of the Software-Defined Network switches used in a carrier's central office to process calls on a per-usage basis. The 4ESS uses a special signaling protocol; when you are buying customer premises equipment, and you think you will be using WATS services, make sure your equipment is compatible with the 4ESS switch protocol.

Connecting Headquarters to Branch Offices

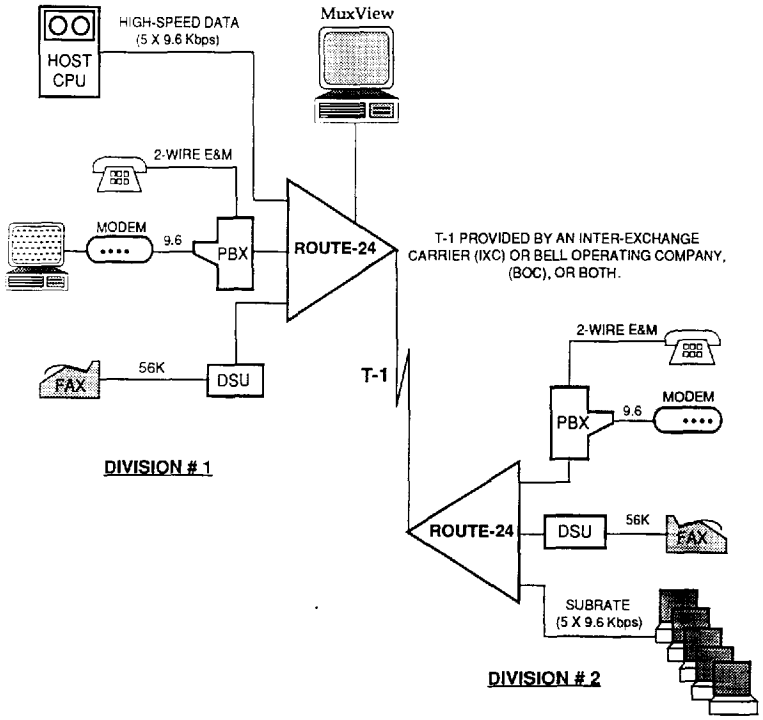


You want to give your corporate headquarters a cost-effective way to utilize all its telecommunication resources, including faxes, PBX's, local and remote terminals, and video. You would also like to take advantage of the special services, offered by T1 network supplies, such as WATS lines, 800 numbers, and switched 56.

Using a Route-24 multiplexer at each location, all of these services can be controlled from the customer premises and used when required, maximizing the utilization (and cost-effectiveness) of the T1 bandwidth.

Benefits in this application: Regardless of the T1 transmission speeds or special services required, Route-24 and MuxView can be used for configuration and control. If the president of your company wants to hold a video conference at 9 AM Monday morning, you can quickly set up a high-speed data link. Once the conference is finished, you can re-allocate your T1 lines to handle your more normal traffic. All of this can be done without disturbing the traffic on your network.

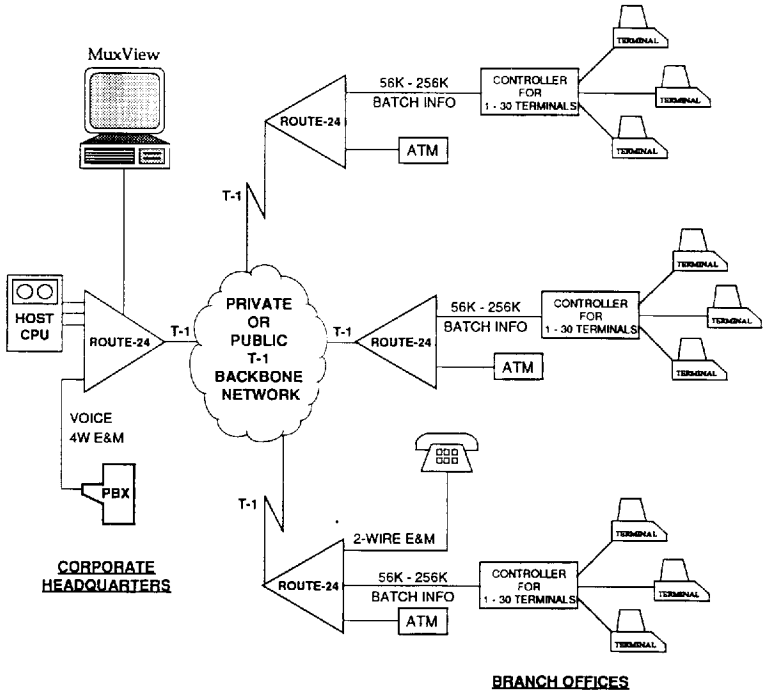
Connecting Company Divisions via Leased T1 Line



This is a private point-to-point network, where you own the equipment and lease a T1 line. Using T1 multiplexers, you have complete control of the configuration of your network. You can send voice, compressed voice, data, and compressed video. You can change your bandwidth requirements at any time. Company divisions can be next door or across the country.

Benefits in this application: A leased T1 line can be a very useful business resource, partly because it is such a flexible transmission medium. To fully tap that flexibility, however, you need the right equipment. You need to be able to adjust your bandwidth to accommodate different devices and faster transmission speeds. You will want to send transmissions at different times of the day. You will want to use a T1 multiplexer which connects to all of your office equipment without a problem and easily accesses all T1 services. Route-24 and MuxView meet all of these requirements.

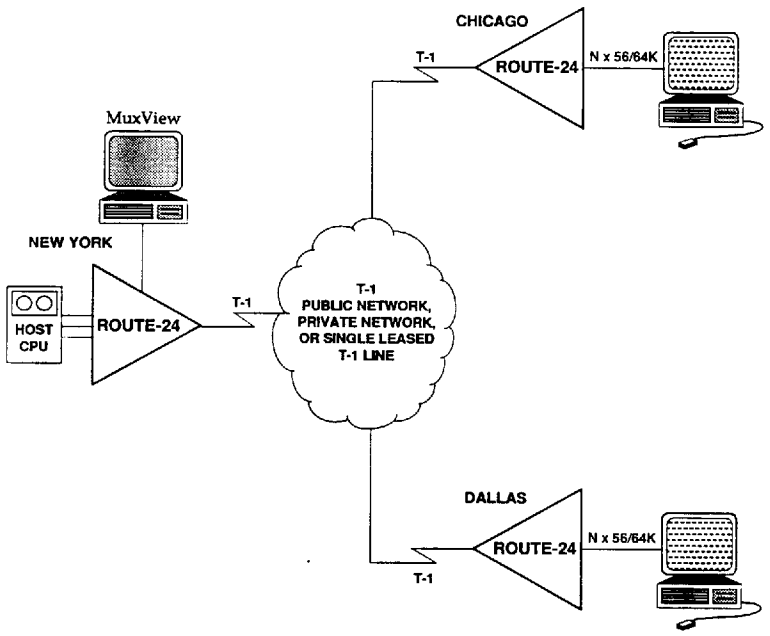
Distributed Batch Data Transmission



If you want to connect a number of terminals (or ATMs) to your host computer, this is the most efficient way to do it using T1 lines. You can connect your terminals to a controller, which can be configured to run at a certain speed. The controller will help transmit data in batches through Route-24, out over a private or public network. You will only need one T1 line coming out from the network to a receiving Route-24 installed where your host computer is located.

Benefits in this application: You can use MuxView and Route-24 to set up automatic time-of-day transmission. This helps you take advantage of lower transmission rates and off-peak periods.

CAD/CAM Application

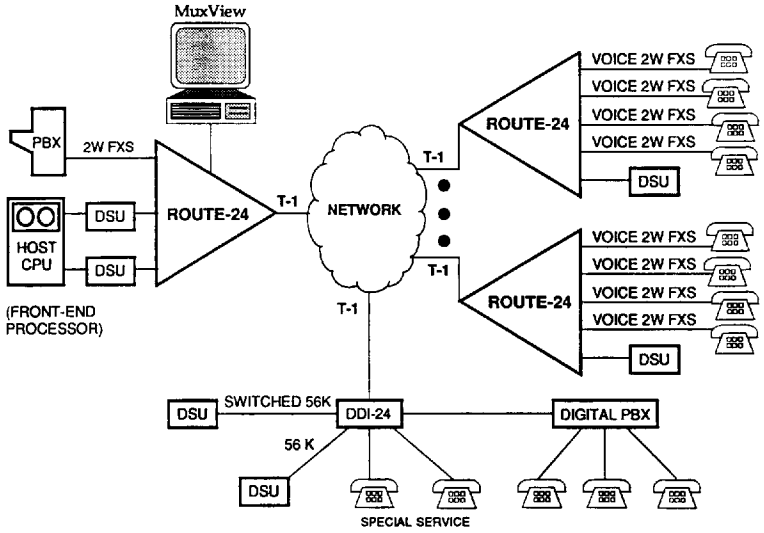


An architectural firm has branch offices in Dallas and Chicago. Each office interacts with New York headquarters on projects. Their CAD/CAM workstations transmit data at low-traffic times, at a speed of 56 thousand bits per second, to a Route-24 multiplexer.

The Route-24 sends the data over T1 lines through a public network. At corporate headquarters, another Route-24 multiplexer receives the data and sends it to the host CPU.

Benefits in this application: In the CAD/CAM environment, application flexibility plays an important role. Let's say you want to transmit and receive data from the Dallas office, at a speed higher than 56 kb/s, and that you want this data transfer to occur at a certain time of day. Using MuxView, you can change the channel speed in Route-24 and transmit data in multiples of 56 kb/s (N x 56K) or 64 kb/s (N x 64K). You could instruct MuxView to transfer the files at midnight, at a rate of 64K.

Accessing 800 WATS Service with FXS Lines



Let's say you want to take advantage of an 800 service so your remote locations can access your PBX or your host computer at your central processing center. This service is charged strictly on a per-usage basis.

For example, a 4ESS switch can be used in the central office to process these calls. This switch is one of the new SDN (software-defined network) switches. The 4ESS switch only accepts a 4-wire E&M signal. For this reason, you would normally have to go through a local operating company, which would convert your 2-wire signals to 4-wire. However, you can access the 4ESS switch directly and avoid going through the local carrier by using the 2W FXS cards in Route-24. This can represent significant savings for you in this type of application. All of the functions you need to interface directly with the 4ESS switch are built into the 2W FXS cards. At a regional office, your voice and data circuits could access the WATS service through a drop-and-insert multiplexer, like Telco Systems DDI-24 Digital Drop and Insert System. A T1 line could be connected to a digital switch; on its way to the switch, individual data and voice circuits could be dropped off, establishing a connection to the 4ESS switch.

Benefits in this application: If you want to take advantage of a WATS service, this is the most cost-effective way to do it. The Voice 2W FXS capability in Route-24 let you access this type of WATS service without first going through a local carrier.

III. Technical Detail

Telco Systems has specialized in multifunction voice and data interfaces to cover almost any application, such as 4W E&M, 2W FXO, 2W FXS, 56/64 kb/s x N, and subrate data. Route-24 complies with PUB 43801 so that it is compatible with the public networks. The intelligence of Route-24 resides not only in the link interface unit (LIU) but also in the channel units. This is done to insure simplicity of design and network compatibility. The smart LIU is a software-controlled device that can be employed in a terminal application. Route-24 can function in either the D4 or extended superframe (ESF) format and supports AMI or B8ZS line coding. With an integral 212A modem, the unit is remotely accessible, allowing testing such as loopbacks and remote provisioning.

Route-24 also offers several types of "smart" channel units that have the capability of local or remote configuration control. All intelligent channel units use nonvolatile memory to store the configuration. In the event of a power failure the units will be automatically restored to their individual specifications upon power recovery. As an added feature, the smart channel units can be monitored through Telco Systems' MuxView management system.

Route-24 has smart and nonintelligent data channel units that accommodate asynchronous, synchronous, DDS-compatible, switched-56 kb/s, and SRDM services. Software-selected data rates are also possible on the smart asynchronous and synchronous channel units. High speed data applications can use the 56/64 kb/s x N channel unit to dynamically allocate bandwidth from 56 kb/s to 1.536 Mb/s. This also provides access to the new fractional T1 services. The channel unit supports V.35, RS-422/449, and RS-232 interfaces, and is protocol independent. The subrate data multiplexer (SRDM) channel unit can segment a 56/64-kb/s channel into twenty 2.4-kb/s, ten 4.8-kb/s, five 9.6-kb/s, or two 19.2-kb/s synchronous channels. Route-24 is compatible with subrate data multiplexing, PUB 54075.

Telco Systems offers the MuxView management system as an effective solution to enhance network control. The system is a graphics-based, mouse-or keyboard-driven program using a series of icons and user-friendly screens to enhance the functionality of the software. From MuxView, the network supervisor can perform local and remote diagnostics, reconfigure channel units, access ESF performance monitoring, and examine statistical reports. Also, MuxView constantly monitors the modem in the LIU for incoming alarm calls. MuxView has multilayered password protection to ensure that the network supervisor controls access to the system.

Route-24 is compatible with all public and private networks that support AT&T PUB 43801. It is also compatible with the following services and specifications:

- M24
- T1 and DS-0
- FCC Parts 15 & 68
- UL compliance
- FONline 800
- ESF monitoring
- Line codes
- Framing formats
- PUB 54075 (Subrate data multiplexing)
- ULTRAWATS and ULTRAWATS 800
- Software defined networks (SDN)
- B8ZS (Bipolar Eight Zero Substitution)
- Clear channel capability (transparent)
- Superframe (SF or D4)
- Extended superframe (ESF)
- PRISM, PRISM1, MCI 800 Service
- MEGACOM and MEGACOM 800
- ACCUNET T1.5, ACCUNET Switched 56
- Fractional T1, including ACCUNET Spectrum of Digital Services (ASDS)
- Synchronization sources: Received T1 signal (looped timing), internal 1.544-MHz clock (master timing), or DDS clock (DDS timing)

Route-24 can interface with any T1 equipment and services having a D3/D4 interface, including:

- A multiplexer in a public or private network
- Digital switching systems
- Channel banks
- Digital crossconnect systems

Easy Plug-in Compatibility on Your Side of the Box

Route-24 is compatible with all of the equipment you think you will be using in your own offices. Equipment attached to a T1 network often includes:

- Host computers and front-end processors
- Facsimile devices
- CAD/CAM workstations
- Compressed video devices
- Personal computers
- Remote printers and plotters
- Statistical and TDM multiplexers
- Analog and digital PBXs
- Key telephone systems
- D3/D4 channel banks

T1 Network Management Tools

Route-24, the intelligent T1 multiplexer, can be configured for any combination of voice, data, or compressed video. The intelligent cards on Route-24 can be set locally or remotely, through a dumb terminal or MuxView, our T1 network management system. Route-24 uses time-division multiplexing (TDM) and pulse code modulation (PCM) to combine voice, data, or compressed video onto a single T1 line. Route-24 is designed for use in customer premises applications. It can be used alone, or with our DS-1 compatible ESF channel service unit, digital crossconnect, low bit-rate voice (ADPCM) system, or digital echo canceller. Route-24 consists of an equipment shelf, an intelligent link interface unit (LIU), and a power supply unit. Each system requires this common equipment. You can then add the interfaces, options, and features you need by plugging in additional modules, one card at a time, and programming the system using MuxView. Route-24 operates under instructions stored in nonvolatile memory on the LIU. A user accesses this memory and controls Route-24 by entering commands from MuxView. MuxView comes in two forms:

MuxView Elite This menu-driven network management program runs on an IBM PC or compatible. It also generates trouble tickets, and generates reports for the network, site, and equipment. A history log is also maintained.

MuxView VT A local or remote terminal can be used to access MuxView. Menus are used to enter commands, set up the system, and perform diagnostics.

MuxView accesses the T1 network through either a local terminal port or a Bell-212 compatible modem port.

Route-24 is completely public-network compatible. It can interface your voice, data, and video devices with any private or public T1 facility or service. Route-24 offers:

Flexible system architecture Route-24 can be configured for your immediate needs and can easily be reconfigured or upgraded in the future, either through software control or by swapping out intelligent hardware cards.

Direct connection You can directly connect up to 24 devices to Route-24, including those for voice, high-speed data, low-speed asynchronous and synchronous data, and compressed video.

Programmable bandwidth Bandwidth for each of your T1 network devices is completely programmable. You can use a portion of a T1 pipeline for cost economy, or you can allocate a large section of the pipeline for video conferencing or high-speed data transmission.

Time-of-day reconfiguration Do you want to take advantage of less expensive, night-time transmission rates? Want to set up an automatic transfer of data at a certain time each day? This can be done in a few seconds with Route-24 and MuxView.

Software-controlled I/O Using software to control your I/O ports locally or remotely is more convenient than physically setting switches or jumpers every time you want to reconfigure a port.

Local or remote control Without affecting the transmission on your network, you can access Route-24 wherever it is installed, locally or remotely, through MuxView.

Automatic or manual You have the choice of setting up automatic or manual configuration control.

Call monitoring All incoming and outgoing calls are monitored continuously. If a problem occurs, you can be notified immediately. Alarms are reported in one of three ways: through a video display terminal, visual alarms on the LIU in Route-24, and external, audible alarms. Route-24 can also dial out, using a built-in modem, to report alarms to a MuxView PC site.

Standard loopbacks Route-24 and MuxView make it possible to conduct a variety of loopbacks.

Remote diagnostics If a problem occurs, you can use a video display terminal to query Route-24. You can isolate the alarm condition to individual system modules or incoming T1 signals. You can insert a digital 1-kHz, 1-mW test tone or quiet code on any voice channel.

- T-1 Line Loopbacks:

  - Outgoing back toward the customer premises
  - Incoming back toward the network

- Voice Channel Loopbacks:

  - Back toward the network or the customer premises

- Data Channel Loopbacks:

  - Back to the network, including any or all subrate multiplexed channels
  - Back toward the customer premises, including all subrate multiplexed channels.

Voice Frequency Units

Route-24 voice frequency modules encode and decode analog voice signals. The channel levels, signaling, and loopbacks of these units are software-controlled. Choices include:

- 4-Wire E&M/TO unit. The 4-wire E&M unit interfaces with an analog voice circuit provided by E&M tie lines. It supports E&M Types I and II signaling, has a 600-ohm interface, and can be configured for normal or tandem tie line and transmission-only applications. It can be looped back toward either the customer premises or the network.

- 2-Wire FXS/PLAR/FXSDN unit. This unit acts as three cards in one, each software controlled. The 2-wire FXS/PLAR/FXSDN unit interfaces with the analog station or switching equipment, such as a PBX. It can be configured for loop start or ground start signaling and a 600-or 900-ohm interface. It can be looped back toward the customer premises. Also, it can be used in private line automatic ringdown applications (PLAR) or in tandem access applications (FXSDN).

Data Units

Route-24 has three types of data modules which support the RS-232C, RS-422/499, and V.35 interfaces with channel data speeds from 2.4 kb/s to 1.536 Mb/s.

- Low-Speed Subrate Data Unit

  - Accommodates quad synchronous rates from 2.4 kb/s to 19.2 kb/s
  - Up to 20 synchronous subrate channels can be multiplexed into one DS-0 channel
  - SRDM Compatible with PUB 54075
  - DS0-A and DS0-B subrate capability
  - Cost-effective alternative to standalone subrate data multiplexers;
  - Automatic channel identification of hardware and software (model number, serial number, and software revision)
  - Recognizes and responds to DDS network control codes: channel, DSU, and OCU loopback

- High-Speed Data Unit

  - Synchronous, protocol transparent
  - Clear channel 64K x N (N = 1, 2, ... 24) support by B8ZS and inverted data option for HDLC
  - Dynamic bandwidth control
  - Time-of-day reconfiguration
  - Software-controlled options (timing, RTS, CTS, etc.)
  - Automatic channel identification of hardware and software (model number, serial number, and software revision)
  - Various loopbacks for diagnostics
  - At 56K x 1, fully-compatible with DDS standards (OCUDP, CSU, and DSU)

- Switched 56 Office Channel Unit

  - Converts 56-kb/s signal from 4-wire customer loop to 64 kb/s DS-0 channel
  - Provides call progress information to switched DSUs for 56 VPN service
  - Various loopbacks for diagnostics
  - Fully-compatible with VPN 56 service standards

Telco Systems T1
Application Guide

Telco Systems Route-24
System Description

Telco Systems 2412-40 LIU
Practice/Installation Manual

Telco Systems 2440-4X 4W E&M/TO Channel Unit
Practice/Installation Manual

Telco Systems 2443-4X 2W FXS/FXSDN/PLAR Channel Unit
Practice/Installation Manual

Telco Systems 2471-40 Low-Speed Data Channel Unit
Practice/Installation Manual

Telco Systems 2474-12 Status 56 Office Channel Unit
Practice/Installation Manual

Telco Systems 2476-4X 4W High Speed Data Channel Unit
Practice/Installation Manual