dialing up for network service

by Dennis Gentry

It's becoming increasingly popular to use ordinary phone lines to connect physically isolated or frequently moved computers to networks. Home machines, for instance, are connected to corporate or university networks (which usually then provide connectivity to the rest of the Internet) and to smaller field offices, where the full cost of a leased line is not justified by the low traffic volume. At this time, NeXT computers are the only computers that can be connected this way by mere mortals.

what's on-demand IP?

Some form of on-demand Internet Protocol (IP) networking software exists for many UNIX workstations, for MS-DOS computers, and for Macintosh computers, although it's typically much more difficult to set up on these platforms than on NeXT computers.

DialupIP is the name of CSNET/CREN's software package that provides IP network services on demand using ordinary phone lines and modems. It's also becoming the generic name for on-demand networking service.

If you're considering setting up on-demand IP, be sure to read the article in this issue about wide area network (WAN) security, which can be compromised easily with on-demand IP if proper safeguards aren't taken. Also, note that when using on-demand IP, network performance is a function of modem speed, so you probably shouldn't bother setting up a general-purpose on-demand IP network using modems slower than 9600 baud.

what's TCP/IP networking?

Transmission Control Protocol/Internet Protocol (TCP/IP) provides networking service by dividing the data to be sent from one application to another (possibly on a different computer) into packets, or datagrams. The main activity of TCP/IP networking is simply delivering packets from one computer to another (or the same) computer. At the lowest level, IP, as shown in figure 1 (see page 30 in the hard copy *support bulletin*), the packets are not guaranteed to be delivered in any particular order, or even

at all. TCP built on top of IP, however, provides reliable, properly sequenced packet delivery by checksumming and adding sequence numbers to the IP packets. All other network servicesÐsuch as mail delivery, remote logins, file transfer, remote file system mounts, network news delivery, and client/ server database accessÐare built on this foundation of IP packet delivery. Probably the most important aspect of TCP/IP networking is that applications need not concern themselves with how data is delivered (for example, via Ethernet, telephone lines, or optical fiber), as long as they use the standard network services and protocols.

how does TCP/IP work?

Historically networked UNIX systems, including NeXT computers, don't use the software and techniques discussed in this article. The operating system waits for a packet from an application to show up, determines which network interface to send it to (based on the destination address in the packet and on the operating system's (OS's) internal routing tables), and then sends the packet out the Ethernet interface, or back into the kernel if the destination is the local machine. There's only one Ethernet interface (named en0) on each NeXT computer, although some computers have multiple Ethernets and are therefore capable of routing packets from one network to another. In case the packet is destined for a remote machine (that is, it goes out the Ethernet interface), the Ethernet hardware interface mostly handles the proper Ethernet framing, including a header and perhaps a trailer.

On the receiving computer, the Ethernet interface receives the packet and passes it to the OS. The OS inspects the packet header for the destination address. If the packet's ultimate destination is elsewhere, the OS ªroutesº the packet or sends it back out some network interface. Otherwise, the packet must be destined for an application on the receiving computer, so the OS strips the header from the packet and dispatches the data inside the packet to the correct application.

how does networking work with on-demand IP?

It's a slightly different story for a machine networked with on-demand IP. All three software packages discussed in the next section implement a new network interface (named du0), which works differently from the Ethernet interface. The new software is dynamically loaded with the kernel and lurks waiting for a packet that needs to be delivered over the serial line (packets that are destined for

the local machine or that should be delivered via the Ethernet, if present, are delivered just as before). When a packet arrives in the kernel ready to be delivered, the software dials the modem and logs into the remote system, if necessary, where a SLIP (Serial Line IP) or PPP (Point-to-Point Protocol) program is run in conjunction with the remote kernel and transmits the packet, using the appropriate framing protocol (SLIP or PPP).

definitions of terms

CSNET/CREN (Computer Science NETwork/ Consortium for Research and Education Network): The CSNET network originally offered services such as mail delivery and Internet connectivity using dialup lines. CSNET merged with BITNET, another educational/research network, to become CREN.

datagram: A sequence of characters (bytes), typically from 1 to 8 KB. More formal synonym for packet.

dialup IP: A technology, also called on-demand IP, that enables IP network connections to be originated only as needed, using the standard telephone system. CSNET/CREN offers a commercial product called DialupIP.

framing: The ªwrappingº around the content of a packet, including a header, trailer, or both.
ICMP (Internet Control Message Protocol): A part of the IP used for error and control messages. Also includes ping packets. See also ping.

IP (Internet Protocol): A connectionless best-effort packet delivery protocol, designed for service between a variety of connected subnetworks. See also TCP, UDP.
NFS (Network File System): Originated by Sun, NFS° allows nearly transparent access to disks on one computer from another via the network.

on-demand IP: See dialup IP.

packet: A more common, less formal term for datagram. See also datagram.

ping (Packet INternetwork Groper): A program that sends test data to let you see if a remote system is connected to the network.

PPP (Point-to-Point Protocol): A newer framing protocol for sending IP packets over serial lines. Includes many optional features, such as link quality determination, header compression negotiation, and per-packet framing checksum.

RFC (Request For Comment): A set of documents published by Stanford Research Institute Network Information Center (SRI-NIC), typically as the documentation of a protocol. Available over the Internet or from SRI. For more information about RFCs, see NeXTanswers network.418.

SLIP or SL/IP (Serial Line IP): A very simple framing protocol for sending IP packets over serial lines. The older, de facto standard for this purpose.

TCP or TCP/IP (Transmission Control Protocol): A reliable stream transmission service using IP (which performs only best-effort packet delivery without guarantees) by handling acknowledgment and retransmission of packets. See also IP, UDP.

UDP (User Datagram Protocol): Unreliable packet delivery service on top of IP. See also IP, TCP.

WAN: Wide area network.

on-demand IP software for NeXT computers

Various software packages provide on-demand IP for the NeXT computer. The two commercial offerings are Morning Star Technologies PPP (yes, the name of the software is the same as the name of the protocol, confusingly enough) for the NeXT machine and Marble Associates' TeleConnect. There's also a publicly available port of CSNET/CREN's DialupIP done by Louis Mamakos at the University of Maryland. All three software packages share some common functionality, although only TeleConnect and Mamakos's DialupIP are descended from CSNET/CREN's DialupIP. Morning Star's

software is derived from Carnegie-Mellon University's PPP code written by Drew Perkins. All three packages work in conjunction with the networking software built into the operating system kernel, which is already based on TCP/IP.

what are the differences in the packages?
Everything described so far works the same for all three packages. The main differences are which framing protocol is used (SLIP or PPP), whether or not the packets are compressed (with Van Jacobson Header Compression), how the packages decide whether and where to send a particular packet, and how the packages are installed and configured.

framing protocols
Two framing protocols are in use for serial lines, SLIP and PPP. SLIP is older, simpler, and probably more widely used than PPP, but it's not particularly versatile. With SLIP, the IP packet to go out is preceded by an escape character at the front and followed by an escape character at the end of the packet, as shown in figure 2 (see page 32 in the hard copy *support bulletin*). If an escape character occurs inside the packet, it's quoted with a different character. SLIP is documented in RFC 1055.

The proposed standard, PPP is newer and includes many optional features, such as link quality determination and header compression negotiation. A particular option is used only if both ends of the PPP link implement it. For example, the NetBlazer (a dedicated on-demand IP computer from Telebit Corporation) currently doesn't implement header compression, although Morning Star's PPP does, so when Morning Star's PPP first connects to a NetBlazer, they automatically agree not to do header compression. This eliminates some manual link administration details one might otherwise have to deal with.

The PPP protocol is much too complicated to describe here, but suffice it to say that it always has slightly more overhead than SLIP, due to its per-packet framing checksum (see figure 3 (see page 33 in the hard copy *support bulletin*)). For this checksum, you get a much reduced chance of corrupted data, especially for NFS operations. PPP (the protocol, not any particular implementation yet) is also capable of directly carrying network traffic other than TCP/IP, such as AppleTalk or Novell network traffic, but the only implementations reported to NeXT have been for IP. PPP is documented in RFC

1171 and RFC 1172.

Morning Star's PPP uses PPP framing (as one might expect), while Marble's TeleConnect and Mamakos's DialupIP use SLIP framing.

header compression

Van Jacobson Header Compression is a method of greatly reducing the amount of overhead on packets for interactive network use, such as for telnet or rlogin sessions. In a normal telnet packet, a single keystroke is accompanied by at least 40 bytes of TCP header information. With header compression, only the first keystroke pays the TCP overhead, and following keystrokes pay only a 2- to 5-byte overhead. This makes on-demand IP reasonable to use for some purposesÐtelnet, rlogin, or mail delivery sessionsÐeven with a 2400-baud modem. It also improves performance a few percent for higher-speed modems and for bulk data transfers such as ftp or rcp. However, even with header compression, you still need at least a 9600-baud modem to provide even mediocre NFS performance.

The sample TCP/IP header in figure 4 (see page 34 in the hard copy *support bulletin*) shows the IP portion of the header (bytes 0-19) and the TCP portion (bytes 20-39), which can be compressed from 39 to 5 bytes.

packet filtering

Not every packet that arrives at the OS kernel should be passed on, either via the Ethernet or via a dialup link. For example, you might not want to allow users on an instructional network to ping machines on the other side of an expensive long-distance link. Or you might want the ping packets to be passed only if the link is already in place.

Morning Star's PPP is the only one of the three packages that lets you filter packets based on nearly arbitrary criteria, although the other two packages allow you to pass packets based on their basic protocol (TCP, UDP, ICMP, and so forth) and source and destination addresses. Morning Star's software lets you specify what kinds of traffic will be passed if the link is already up but which will be thrown out if the link is not up. It also lets you specify the kinds of traffic that will keep the link up, but

that will not bring it up in the first place. This may sound like overkill, but all these filtering options can be very useful in keeping your long-distance phone charges to a minimum while providing the network services you really want.

installation and configuration

All three of the packages are provided as Installer packages, so getting their files onto your system is a simple matter of unpackaging things. Configuration of those files is a slightly different matter, though. Because Marble's TeleConnect and Mamakos's DialupIP are descendants of CSNET/CREN's DialupIP, once installed they provide nearly the same features. However, Marble has enhanced DialupIP with a NeXTstep configuration application (TeleConfigure) and monitoring application (TeleMonitor) to make it easier for those who aren't UNIX administrators to configure and monitor the software.

Morning Star's PPP is a fresh implementation of the more modern framing protocol; it uses a different, simpler set of configuration files from the other two packages but doesn't yet include a NeXTstep configuration application. The product also runs on Sun° workstations, making it easy to interoperate between NeXT and Sun workstations. For example, you could take home your NeXT computer running Morning Star's PPP and easily connect to the network of Sun workstations (one of which would also need to run PPP) at the office.

comparative benefits

Morning Star's PPP package is probably the simplest to use from a system administrator's point of view. It uses the most modern and solid protocol, implements header compression for good interactive performance, and provides excellent packet filtering capability. As of this writing, Morning Star doesn't yet provide an easy-to-use Installer application (although one is in the works and should be available soon). If you're uncomfortable with UNIX, you'll likely find the configuration application included with Marble's package easier to use.

Marble has a marketing agreement with Neuron Data, makers of the Neuron high-speed data and fax modem, so you get TeleConnect with every Neuron modem. They also have an agreement with PSI, one of the two leading network service providers (UUNET, providing AlterNet service, is the other

one), so you can connect to the worldwide Internet for a flat monthly fee. You could probably use the other software packages with the Neuron modem and PSI, but there are likely to be fewer hassles using Marble's software, because presumably they've at least tried it out with these products.

If you're unable to spend money on a software package, Mamakos's DialupIP port may be the way to go. Once properly installed, it seems to work reliably. But keep in mind that you'll need to find or develop some technical expertise: there's no direct support, sources aren't available, and you have no guarantee that the software will work with any later version of the OS. While you don't get sources from Marble or Morning Star either, you do get some technical support and bug fixes.

references

Comer, Douglas. *Internetworking with TCP/IP*. Englewood Cliffs, NJ: Prentice-Hall, 1991.

Jacobson, Van. RFC 1144: *Compressing TCP/IP headers for low-speed serial links* (February 1991), 43 pp.

Perkins, D. RFC 1171: *Point-to-Point Protocol for the transmission of multi-protocol datagrams over Point-to-Point links* (July 1990), 48 pp.

Perkins, D. and R. Hobby. RFC 1172: *Point-to-Point Protocol (PPP) initial configuration options* (July 1990), 38 pp.

Romkey, J. L. RFC 1055: *Nonstandard for transmission of IP datagrams over serial lines: SLIP* (June 1988), 6 pp.

Waitzman, D. RFC 1149: *Standard for the transmission of IP datagrams on avian carriers* (April 1, 1990), 2 pp.

companies offering on-demand IP products

The following is a list of companies offering on-demand IP products. NeXT does not specifically

endorse any of these products.

Marble Associates
Waltham, MA and San Jose, CA
Phone: 408-436-7299
Fax: 408-436-7147

Morning Star Technologies
Columbus, OH
Phone: 614-451-1883
Fax: 614-459-5054

Neuron Data, Inc.
Princeton, NJ
Phone: 609-452-1100
Fax: 609-452-8495

PSI, Performance Systems International
Reston, VA
Phone: 703-620-6651
Fax: 703-620-4586

Telebit Corporation
Sunnyvale, CA
Phone: 800-835-3248, 408-734-4333
Fax: 408-734-3333

UUNET
Falls Church, VA
Phone: 703-876-5050
Fax: 703-876-5059

Note: Mamakos's DialupIP may be retrieved via anonymous FTP from the NeXT Internet archive sites cs.orst.edu or sonata.cc.purdue.edu.

Note: 800 numbers are accessible only from the United States and Canada.