GETTING TO THE INTERNET:
ONE MARINE LIBRARIAN'S SOLUTION TO REACHING
SOME OF 'THE TOOLS OF OUR TRADE'

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ABSTRACT

Technology does not always come as rapidly to remote field stations as it does to laboratories located in more urban or industrialized locations. Accessing global computing networks, for example, can be a costly and time-consuming proposition from the field station. Until recently, researchers, staff, and students working at the University of California Davis (UCD) Bodega Marine Laboratory (BML), located in Bodega Bay, Sonoma County, California, USA, had two means of accessing global computing resources to use mainframe- and super-computers, genome and library databases, the Internet, etc. One option was for each individual to drive 200 miles (322 km) to the main campus and spend a day at the campus computer center. The second option was for an individual to use the 2400 baud modem attached to the BML Library's OPAC to dial long distance into the campus network. Access to the modem was restricted to one user at a time and the OPAC could not be consulted if someone was using the modem. There were numerous difficulties associated with conducting elaborate searches and file transfer procedures via a 2400 baud modem. Additionally, the Library's phone bills reached $580 (US) per month and were increasing monthly as more researchers began to take advantage of this service.

The BML librarian sought to increase BML's global interconnectivity more cost effectively by 'joining' the UC Davis computing network (UCDnet), which is part of larger wide-area networks that make up the Internet. This was accomplished by leasing a 56 Kbps digital circuit between Bodega Bay and Davis, California, that establishes a continuous link to UCDnet 24 hours/day, 365 days/year at a fixed cost of $671 (US)/month. Hardware and software to transport data over this leased circuit, and
a 10baseT local area network (LAN), which allows distributed multiple-user access to the circuit, had to be installed at BML. As a result of this project, BML is now a subnet on UCDnet allowing BML researchers to use campus and global computing resources from their own desktop IBM PC's and Macintosh computers. Additionally, resources on BML computers can now be made available to distant users via the Internet. This paper details the specifics of this project which cost approximately $18,000 (US).

WHAT IS THE INTERNET?

The Internet (big 'I' and little letters) is a global network of interconnected computer networks. The Internet, as we now know it, evolved from US Department of Defense research projects designed to provide communication links between remote and dissimilar computers so that scientists could share and access resources on these different computers. The first test of the network occurred in September 1969 when a Honeywell minicomputer at University of California Los Angeles successfully passed information to 3 similarly programmed computers at University of California Santa Barbara, Stanford Research Institute, and University of Utah. The success of this initial experiment has led to an ever-growing network that is difficult to accurately quantify. October 1992 estimates indicate that more than 39,000 different networks, in more than 107 countries, representing more than 727,000 individual computers and 4-5 million individuals make up what we refer to as the Internet.

A major prerequisite to successful communication between different computers is establishing specific languages and procedures that allow different computers to speak to one another. Such procedures have been agreed upon by all network participants and are managed in the US by SRI International (Menlo Park, California, USA) who operates the Network Information Center (NIC). TCP/IP, or, the "Internet Protocol Suite" (Figure 1) is the most commonly used set of instructions.

A second prerequisite to successful communication is a mechanism to move and route messages across networks. This mechanism is called "packet-switching". Information is broken into datagrams by TCP/IP, which attaches headers and routing information to the body of a message. Datagrams are then sent in bursts across phone lines, data lines, satellite links or via radio signals to the destination indicated in their headers. Datagrams from different communications sessions can be interspersed along the same line, and if equipment fails along the route, datagrams can be rerouted without affecting any sessions. This ability to support multiple, simultaneous sessions is one of the main advantages of packet-switched (vs circuit-switched) communication networks. Packet-switching systems automatically adjust data transmission speeds to allow PCs and Macs to communicate with mainframes and other computers.
IP = Internet protocol. This protocol defines the basic segment of
information, called the "datagram"; and specifies the exact format of
information as it travels along the Internet to its destination.
Routines to route, forward, and store data are also provided.

TCP = transmission control protocol. This protocol controls the flow of
datagrams across the Internet; verifies and resends lost or damaged datagrams;
and reassembles datagrams correctly when they reach their final destination.

Other commonly used Internet protocols include:

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACIP</td>
<td>protocol suite used by Macintosh computers</td>
</tr>
<tr>
<td>UCP</td>
<td>user datagram protocol</td>
</tr>
<tr>
<td>ICMP</td>
<td>Internet control message protocol</td>
</tr>
<tr>
<td>OSI</td>
<td>open systems interconnection protocol</td>
</tr>
<tr>
<td>FTP</td>
<td>file transfer protocol</td>
</tr>
<tr>
<td>SMTP</td>
<td>simple mail transfer protocol</td>
</tr>
</tbody>
</table>

**FIGURE 1:** TCP/IP and Internet Protocols.

Ethernet is one of the earliest packet-switching technologies developed and is very
much in use today. Ethernet is actually a set of standards and specifications that
inform the physical cabling and electrical signals of a network. Ethernet transmits 10
Mbps (10 million bits per second), taking 100 nanoseconds (a billionth of a second) to
transmit each bit, over thick, thin, or twisted-pair wiring (each of which carries bits at
such speeds over a prescribed physical distance).

**WHY CONNECT TO THE INTERNET?**

There are many databases, online library catalogs, campus information systems,
directories, full-text publications, and other services available free through the Internet.
A researcher may wish real-time access to remote computers to run statistical analyses,
use supercomputers, operate radio telescopes, or search genetic databases.

Researchers collaborating on research projects may need to transfer data,
graphic, and text files among themselves or interested colleagues. The range and
number of possibilities available through the Internet grows daily.
Three services that enable such interactions across the Internet are supported by TCP/IP:

Email = electronic mail. An individual on any networked computer can send electronic messages (text or binary format) to individuals on any other networked computers in the world. Messages are delivered to their destination in seconds or minutes and the recipient can read and respond to messages at her/his convenience, thus eliminating time zone differences, long-distance phone charges, and delays caused by mail delivery.

Telnet = remote login. This network terminal emulation protocol allows an individual to log on to any other networked computer in the world (provided the individual has appropriate login id and password) and operate the remote computer in real time as if s/he were sitting at a keyboard directly attached to the remote computer.

FTP = file transfer protocol. This protocol allows a user on any networked computer to get and put files between her/his local computer and any remote networked computer in the world. Using ftp, a researcher can send or copy large data files, software, and documentation in seconds from computers all over the world.

The Internet has no membership fee; however, institutional costs vary greatly and may include the following and more: equipment to connect to the nearest backbone; fees paid to wide area networks; leased lines to transport data (56 Kbps, T1, T3, fiber optics, etc.); and extensive staffing to maintain the physical connection, software, local databases, and to provide local technical and user support.

HOW DID BML CONNECT?

Bodega Marine Laboratory (BML) is an organized research unit of the University of California (UC), administered by the Davis (UCD) campus. Located in a small coastal fishing village, 100 miles (161 km) from the main campus, BML has both research and resident instructional programs. The BML Library is not part of the UCD Libraries and receives no financial or administrative support from campus libraries. The University maintains the MELVYL online library catalog but BML library holdings do not appear in MELVYL. The BML librarian creates an online catalog and related databases, using INMAGIC software, that reside on the Library's IBM PC.

Access to campus and global computing facilities is vital to the operation of a university-level research and instructional facility. In order to support the general computer and library information needs of researchers, students, staff and the librarian at BML, individuals obtained passwords to access UCD computers via long-distance dial-up access. Not only was dial-up access expensive, but the connection was often
slow or unreliable due to technical difficulties in transmitting data signals over voice-grade phone lines.

The Library had one IBM PC and one Hayes 2400 baud modem that were used by all BMLers to reach campus computers. Demand for the computer grew so great the librarian could barely get time on her own computer, so she purchased a second PC and the two computers shared the modem. Soon the librarian could not gain access to the modem to perform her duties so a second modem was purchased. The librarian also maintained a "sneaker" network—running between the two library computers to transfer files, update databases, etc.

More computing services were needed by BML residents, additional software and databases were made available through MELVYL and other computers, and BML residents demanded more and better access to these services. Several researchers purchased their own modems and generated high phone bills accessing campus and global computers. The Library’s phone bills alone were approximately $500-$600/month just to UCD. UCD began to computerize more of its accounting and personnel operations, so BML administrative staff needed computer access to perform their daily tasks. Researchers on campus also needed access to BML data, databases, and the BML Library catalog. It became apparent that more users needed access to BML, campus, and global computer networks and more users needed to share the costs of this access.

In June 1989 the Librarian met with the UCD Computer Center’s Communications Manager to discuss how BML might join the campus computing network (UCDNet). He informed me that we needed to do two things to join UCDNet: 1) BML needed to lease a data circuit to the closest point-of-presence for the Internet (Physically the closest point-of-presence is 40 miles from BML; however, for political reasons, we were required to tie in to the UCD point-of-presence, 100 miles away, which significantly increased the installation and monthly costs of our project.); and 2) We needed to install a local area network (LAN) at BML to distribute access to the data circuit to multiple, simultaneous users. While this sounded simple at the time, it took 14 months to complete the project and involved: finding the right people to talk to and work with (this was our single biggest hurdle and caused all our delays!); learning all about data circuits; network hardware and software, phone closets, wiring, and jacks, Ethernet and 10baseT, etc.; preparing "shopping lists" and getting price quotes; finding the money to complete the project; establishing time frames and completing various sequential tasks; and many other steps. (Project costs are summarized in Figures 2-4).
<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>TOTAL ($ US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NAT router</td>
<td>$ 1,720</td>
</tr>
<tr>
<td>2</td>
<td>NEC csu/dsu</td>
<td>$ 1,290</td>
</tr>
<tr>
<td>1</td>
<td>UPS</td>
<td>$ 710</td>
</tr>
<tr>
<td>1</td>
<td>Campus telecommunications fee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Installation fee</td>
<td>$ 350</td>
</tr>
<tr>
<td></td>
<td>Recurring fee</td>
<td>$ 70/month</td>
</tr>
<tr>
<td>1</td>
<td>56 Kbps dedicated circuit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Installation fee</td>
<td>$ 2,400</td>
</tr>
<tr>
<td></td>
<td>Recurring fee</td>
<td>$ 603/month</td>
</tr>
</tbody>
</table>

**SUBTOTAL:** COST UPFRONT $ 6,470

**ANNUAL RECURRING COSTS** $ 8,076/year

**FIGURE 2. BML CIRCUIT COSTS.**

Each step of our project presented new questions that needed to be answered before we proceeded. Regarding the data circuit:

- where was the closest (or most "politically correct") point-of-presence for the Internet?;
- what size data circuit provided the fastest speed for our money and which carrier gave us the best price to reach it?;
- who had ultimate authority to allow us to use that carrier and who prepared the work order to get the job done?;
- what equipment did we need to reach this point-of-presence?;
- what did the equipment cost and from what vendor should it be ordered?;
- what were the electrical power requirements for this equipment and was there sufficient electricity in spaces where the circuit and equipment would be installed?
- would we need a UPS for any of the equipment, and what load did the UPS need to bear?;
- was there physically enough space to accommodate new equipment, jacks and cables where we needed to install them?

etc...
<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>TOTAL ($ US)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Consultant's fees &amp; travel</td>
<td>$ 1,100</td>
</tr>
<tr>
<td>1</td>
<td>Wiring job (supplies &amp; labor)</td>
<td>$ 3,000</td>
</tr>
<tr>
<td></td>
<td>Pull thin Ethernet coax; modify all phone jacks; pull new UTP wire;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>install demarc punch blocks in phone closets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>test &amp; prove out system</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BML labor &amp; supplies clear phone closets of old cables; install</td>
<td>$ 400</td>
</tr>
<tr>
<td></td>
<td>dedicated electrical circuits to all phone closets; survey conduits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>prior to pulling Ethernet coax</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cabletron MRXI hubs</td>
<td>$ 4,300</td>
</tr>
<tr>
<td>3</td>
<td>Asante 10baseT network cards &amp; cables for Macs</td>
<td>$ 570</td>
</tr>
<tr>
<td>10</td>
<td>Asante 10baseT network cards &amp; cables for IBM</td>
<td>$ 1,400</td>
</tr>
<tr>
<td>1</td>
<td>Labor to install network cards &amp; cables for IBM</td>
<td>$ 200</td>
</tr>
<tr>
<td>3</td>
<td>50' &amp; 100' Ethernet 10baseT cables</td>
<td>$ 100</td>
</tr>
<tr>
<td>1</td>
<td>NCSA TCF/IP software for IBM</td>
<td>FREE</td>
</tr>
<tr>
<td>1</td>
<td>MACIP software for Mac</td>
<td>FREE</td>
</tr>
<tr>
<td>1</td>
<td>Versaterm software to really allow Macs to use network</td>
<td>$ 200</td>
</tr>
<tr>
<td></td>
<td>SUBTOTAL: COST UPFRONT</td>
<td><strong>$11,270</strong></td>
</tr>
<tr>
<td></td>
<td>ANNUAL RECURRING COSTS</td>
<td>0</td>
</tr>
</tbody>
</table>

**FIGURE 3. BML LAN COSTS (26 STATIONS).**
TOTAL PROJECT COST
COST/STATION
$ 17,740
$ 682

[NOTE: We did not purchase network cards for all workstations; if we had, total project cost would be $1,820 higher and cost/station would be $752/station.]

TOTAL RECURRING COST
COST/STATION
$ 8,076/year
$ 311/year

BML STAFF TIME AND SALARY COSTS FOR
Network planning,
Network installation
Network troubleshooting,
Network management,
Network maintenance
WHO KNOWS?!!

ACTUAL RECURRING COST/STATION
LIBRARY $4,038/year
EACH RESEARCH GROUP AT BML $576/year

FIGURE 4. TOTAL COSTS TO CONNECT BML TO UCDNET AND THE INTERNET.

We compared circuit prices from various vendors and decided to contract with the State of California Telecommunications Division for a 56 Kbps data circuit between Bodega Bay and Davis at a cost of $602/month. Both the installation and monthly costs would have been reduced if we were politically able to tie into a closer point-of-presence; however, we made our link directly into our own campus's Internet point-of-presence. Since BML was the first off-campus site to tie into UCDNet, campus administrators had to determine which equipment would become the campus standard for UCDNet access. Setting these standards took months and many memos between BML and the campus! Although aggravating at the time, the delay in making these decisions actually worked to our advantage because the price of the equipment dropped while campus staff decided what they would allow us to buy. In the meantime, BML had to add 4-plug dedicated and grounded electrical circuits into all the phone closets to accommodate the new equipment.

Regarding our LAN:

what type of LAN did we want: server-based, non-server, star-topology, token-ring, bus topology?;
how many stations needed access to the network, where were they physically
located, and what exact models of computer were at each location;
what type of wiring would we use in the network: 10baseT, thin Ethernet coax,
 thick Ethernet coax?
what condition/specification/gauge was BML’s existing phone wiring, how many free pairs of phone wires were available at each station, and was existing wiring 10baseT compatible?
what was the physical distance between stations and phone closets?
what type and how many cables and hubs would we need to connect the network?
was there sufficient electricity in all locations where hubs would be located?
what network software would be used?
who would serve as the network administrator, assign IP addresses and maintain network databases, provide security, and troubleshooting?
who would install the network boards and install and configure the network software?
who would train users? ... and the list continues.

We hired UCD computer consultants to help us design a 10baseT star-topology network in theory (on paper). These consultants then made a site-visit to BML to inspect and test our existing phone lines and to verify that our design would work. 10baseT is the 1990 IEEE standard for running 10 Mbps Ethernet signals over the unshielded twisted-pair (UTP) wiring commonly used in recent US telephone installations. 10baseT network specifications:

assume the basic unshielded twisted-pair (UTP) wiring system of a typical US phone installation;
require that all stations on the LAN interconnect to a hub/concentrator/concentrator;
mandate that 24 AWG (American Weight Gauge) UTP wires are used, two specific pairs of which are required to receive and transmit data;
require that each computer on the network has either a 10baseT network card or an external 10baseT transceiver, and a cable that fits into an RJ-45 receptacle (an 8 conductor modular connector in the phone jack); and specifies that stations can be no more than 330 running feet (100 m) from a hub and must be able to transmit a signal at a specific decibel level.

One of the first things we learned during the consultants’ site-visit, was that BML not only had the wrong phone jacks (they were not RJ-45 jacks), but that each jack connecting to the LAN had to be rewired because 10baseT requires a specific pair of wires (pairs 1&2, 3&6) be used to transmit and receive data. In some cases new phone wire had to be pulled to offices from the main phone closet because there were no free pairs available in these offices. All of the 10baseT connections also had to be pulled out of the main phone system punchblocks and punched down into new LAN-only punchblocks in each phone closet.

We were able to use existing UTP wire to connect computer workstations to LAN
punchblocks in our phone closets using 10baseT technology. But because our buildings are greater than 300 feet (100 m) apart, we had to pull thin Ethernet coax cable through an underground conduit to link the two buildings. We also used thin Ethernet coax as the "backbone" to link the hubs in our network into a star-topology. This backbone insures that our network will continue to run if any hub on the network becomes disabled and also gives us room to expand the network at any time.

We accomplished all these tasks; loaded and configured NCSA public-domain software (with no manual!) per individual specifications on each computer; programmed hubs; trained users; reloaded all front-end interfaces on the BML Library computer; performed troubleshooting due to software and hardware conflicts; and documented our entire network—from floor plans to cables to software configuration. The network has been successfully running for four months and use increases daily. We are still figuring out how to fully implement the software, but the BML community is extremely pleased with the speed and reliability of our network. BML is now fully connected to the global computing community and researchers, students, staff AND LIBRARIAN feel less remote than our physical location would indicate.

OTHER WAYS TO GET CONNECTED TO THE INTERNET

There are other ways to gain access to the Internet without leasing data circuits and installing local area networks. Some other possibilities include:

1) Dial-up access via modem and communications software to your nearest point-of-presence -- may be your home institution; a neighboring public/private institution, government agency, corporation; or a regional network (WAN). You may be able to work out formal or informal means of gaining access by negotiating with other agencies and institutions.

2) Dial-up host using SLIP (serial line Internet protocol) which supports transmission and receipt of IP packets over a standard serial interface (see Hein 1992 for additional details) on a Sun Microsystems workstation.

3) Network service resellers -- for profit and not-for profit companies that provide basic network connections and related services. There are various levels of service and cost associated with these; some offer full Internet access (email, ftp, and telnet) while others provide only partial Internet access and service. A list of many of these resellers, is available via email, ftp, (FIGURE 5) or from the author.
A list of public access service providers offering dialup access to outgoing Internet connections such as FTP and telnet.

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-1- Summary: Providers With Wide Area Access
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-3- Summary: Phone Prefixes For International Dialins
-4- What *Is* The Internet?
-5- What The PDIAL Is
-6- List of Providers
* -7- How People Can Get The PDIAL (This List)
-8- Appendix A: Finding Public Data Network (PDN) Access Numbers
* -9- Copyright and Distribution Of The PDIAL; Other Notices

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Peter Kaminski    | Internet: kaminski@netcom.com
The Information Deli | CIS: 71053,2155
"connecting people" | AMIX: PKAMINSKI

To get the Public Dialup Internet Access List, send email with the subject "Send PDIAL" to "info-deli-server@netcom.com".

From: PDIAL -7-
Subject: How People Can Get The PDIAL (This List)

USENET: The PDIAL list is posted regularly to
alt.internet.access.wanted,
alt.bbs.lists, ba.internet, and news.answers.

EMAIL:

From the Information Deli archive server (most up-to-date):

To receive the current edition of the PDIAL, send email with
the subject "Send PDIAL" to "info-deli-server@netcom.com".

To subscribe to a list which receives future editions as they
are published, send email with the subject "Subscribe PDIAL" to
"info-deli-server@netcom.com".

To receive both the most recent and future editions, send
both messages.

From the news.answers FAQ archive:

Send email with the message "send usenet/news.answers/pdial"
to "mail-server@pit-manager.mit.edu".

For help, send the message "help" to
"mail-server@pit-manager.mit.edu".

FTP ARCHIVE SITES (PDIAL and *lots* of other useful information):

As part of a collection of public access lists:
GVL.Unisys.COM:/pub/pubnet/pdial [128.126.220.104]

As part of the ba.internet FAQ:
wiretap.spies.com:/ba.internet/Services/%LISTS/PDIAL/
[130.43.3.3]

As part of an Internet access compilation file:
liberty.uc.wlu.edu:/pub/lawlib/internet.access
[137.113.10.35]
As part of the news.answers FAQ archive:
pit-manager.mit.edu:/pub/usenet/news.answers/pdial
[18.172.1.27]

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NCSA Telnet for the PC, version 2.2TN and Version 2.2D. Software and
Carolina, Institute for Academic Technology. 7 p.
CDS/ISIS and USMARC

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Virginia Institute of Marine Sciences
Library
Gloucester Point, VA 23062 U.S.A.

ABSTRACT

CDS/ISIS is UNESCO's free library automation software. It can be used on a PC or a larger computer (VAX). A PC network version is being tested and a UNIX version is imminent. One of the central failures of library automation systems is inflexibility. By importing and exporting records in the International Standards Organization format, it solves the communications problem. It is estimated that there are 15,000 CDS/ISIS users worldwide. Yet there are very few users in the US. Why don't more US libraries share in this universal brotherhood with its obvious benefits? One of the reasons is CDS/ISIS does not directly import USMARC records.

The paper will detail how to import USMARC records into CDS/ISIS, how the experience can be the gateway to importing any kind of record into the system (ASFA, DIALOG, WordPerfect, dBase) and why this is all part of the CDS/ISIS philosophy.

INTRODUCTION

CDS/ISIS, UNESCO's free bibliographic software, has a worldwide user base of more than 15,000, making it perhaps the most popular library automation software. However, in the US there are few users, very few in libraries not related to the United Nations.

The software has obvious advantages in addition to its broad user base. Since it is designed as the world's program, it implements the International Standards Organization (ISO 2709) format for the transmission of bibliographic information. Data exchange among users is guaranteed; the program forms a communications bond among them. Even if UNESCO folded, or if Giampaolo del Bigio fulfilled a lifelong dream and entered the Certosa di Calci, the program would live on and thrive. In an era of library automation when software can cost three times the amount of the hardware and can be in the hundreds of thousands of dollars, CDS/ISIS has a mainframe version which is free. In an era when entire systems are dumped as a prettier face appears, CDS/ISIS guarantees its longevity by refusing to commit to one