



PACKET

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President's Corner

What a great past year! We had our ups and downs during the year, but overall, it was a very productive year. 1998 looks to be a strong year as well. Several projects should be rolling out this year, including the DGPS Reference Station, John Ackermann's Wireless TCP/IP book, the METCON-II kit, and, with luck, at least one SS radio offering. I'll let the whole of the PSR speak for what is happening, so no need for me to duplicate that information here.

I would like to thank everyone who volunteers time to make TAPR work. I can't even begin to list everyone, but let's hit on a few areas that are very important to how TAPR acts as an organization. People like Larry Keeran, K9ORP, who maintains the APRS SIG file area, you can't imagine the weekly work Larry does in answering questions and making sure all those new files get moved someplace on the system. Greg Eubank, KL7EV, who maintains the TAPR software lib. Chuck Martin, KD6NUJ, who weekly records and encodes the Newslines audio for the TAPR web page for so many others to listen to. We had over 50,000 accesses to the audio pages Chuck makes possible. Lee Ziegenhals, N5LYT, who provides space and makes the TAPR.ORG system possible with its terrific access to the Internet and dedicated expertise when things are not running so smooth. To all the

Look for TAPR at these Upcoming Events

May 15-17, 1998 Dayton HamVention

Sept. 1998 ARRL & TAPR Digital Communications Conference
- Chicago, Illinois

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President's Corner, continued...

volunteers who answer technical and information questions like Ron Parsons, W5RKN and Keith Justice, KF7TP, to name just a few. Without the volunteers that Dorothy draws upon to help answer questions or help members debug kit problems, we wouldn't be very successful in what we do. The volunteers that help 'elmer' others past their problems are the best! To all the SIG chairs who maintain the life blood of communications on various discussions and organization sub-groups that make up TAPR. When we started the various lists in 1991, I never thought that they would turn into such an important communications tool to, and between our members. To all those that help with project design and development that keep coming back year after year to provide technical challenges for the rest of us to learn from and gain experience by building and getting these things operational — you know who you are. Finally to all the members that renew each year to support what TAPR is about. Between the efforts of those actively involved personally and to those who just read the *PSR* each quarter, TAPR is as strong as the membership as a whole. I only see very positive things from the current membership base.

With all the great praise out of the way :-), I now want to ask everyone to help with a fund raiser for the 900MHz FHSS radio project budget. We have money allocated, but we will need more than we have available in the R&D funds to support what is needed. The project is progressing very nicely with the CPU now operational and the RF sections being tested and brought up to speed. A project report is available in this issue and photos and audio are on the web project page (<http://www.tapr.org/ss>). Any money we can raise will allow us to continue to fund the other projects scheduled for this year as well as fully support the radio project. When this issue came up last month, someone thought this was a lot of money for the next 12-18 months. Many don't realize that the original TNC-2 effort cost TAPR a little over \$100,000 to fully pull off. I hope that this project doesn't require that much cash in the long run, but it easily could if we have to do initial production of the units ourselves, much like the TNC-2 in 1984, to make the unit a reality for the amateur radio community at a price we all want to see.

A few things to look for in 1998 include the ARRI and TAPR Digital Communications Conference to be held in Chicago, in September, with CAPRA as the local hosts. The Chicago conference looks to be as strong as this last year's in Baltimore, so I hope everyone that couldn't attend the 1997 conference can make it this year. Don't forget that the Dayton HamVention will be on May 15, 16, and 17. We expect another strong speaking schedule on Friday afternoon and we should have some concept of the banquet speaker for our dinner by the next *PSR*.

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Date is expiration of term on Board of Directors.

The Tucson Amateur Packet Radio Corporation is a non-profit scientific research and development corporation [Section 501(c)(3) of the U.S. tax code]. Contributions are deductible to the extent allowed by U.S. tax laws. TAPR is chartered in the State of Arizona for the purpose of designing and developing new systems for digital radio communication in the Amateur Radio Service, and for disseminating information required during, and obtained from, such research.

Article submission deadlines for upcoming issues:

Spring 1998	March 15, 1998
Summer 1998	June 15, 1998
Fall 1998	September 15, 1998
Winter 1999	December 15, 1998

Submission Guidelines:

TAPR is always interested in receiving information and articles for publication. If you have an idea for an article you would like to see, or you, or someone you know, is doing something that would interest digital communicators, please contact the editor so that your work can be shared with the Amateur community.

The preferred format for articles is plain ASCII text; the preferred graphic formats are HPGL or PCX. However, we can accept many popular word processor and graphic formats. All submissions on diskette should be formatted for MS-DOS.



President's Corner, continued...

To finish, let me point out that this is election time of year. We have four people running for the three slots available on the TAPR Board of Directors. Each member has strong credentials, so please take a moment and look over the election information and send in your vote. The TAPR Board of Directors is responsible for setting directions and goals of the organization, so this is your opportunity to have a say. We will again be accepting ballots printed in this PSR as well as doing an on-line balloting system. Please vote!

Until next quarter and lots more fun!
Cheers - Greg, WD5IVD

TAPR Board of Directors Elections

The following four members have agreed to run for the three available positions on the board of directors. You may vote for these individuals and/or any write-in candidates using the ballot printed on the next to last page of the PSR or using the on-line election web page (details to follow).

Deadline for balloting is March 1st, 1998. Board members elected will serve a three year term.

The following TAPR members have been nominated for election this year to the TAPR Board of Directors.

John Ackermann, N8UR (ex-AG9V)
Jim Neely, WA5LHS
Barry McLamon, VE3JF
Doug McKinney, KC3RL

Jim Neely, WA5LHS
Voice: (512) 604-3012
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I have been licensed since 1963 and involved in digital communications since the Viet Nam war in the middle to late 1960s. During the '60s I ran phone patches and teletype traffic on Air Force MARS networks.

In the early '80s I became involved in packet communications and was one of the contributors to the Texas Packet Radio Society's TEXNET system. The Austin Texas TEXNET node still bears my call. It was the first TEXNET node outside of the Dallas-Ft. Worth area and is the pipeline node between the northern and southern portions of TEXNET.

I have been involved in TAPR since the late '80s and have served two terms as a director and have been the treasurer since 1992.

Doug McKinney, KC3RL
Telephone: (408) 663-4999
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My wife and I started as two-year Novices in 71. We became HAMS again in 83, for myself, and 86 for Beverly KC6AMI. I became very active in ATV and Packet, but ATV dominated. I have co-authored magazine articles in AUTO-CALL and SPEC-COM and authored articles in AMATEUR TELEVISION QUARTERLY and 73 Amateur Radio Today (with several other articles mentioning my activities). My photograph has been published and republished in chapter 16 of the ARRL OPERATING MANUAL. Therefore, I kept my call due to my ATV involvement.

I am the President of the Naval Postgraduate School (NPS) Amateur Radio Club (also in 87, 89, and 91) and the originator of WINTERFEST in the central California area. I am presently running our 7th WINTERFEST. WINTERFEST is a free public event, which demonstrates all the modes of HAM Radio to the public in an indoor/outdoor setting and uses the flea marketers table renting to pay for the event. I wanted a HAMFEST which actually demonstrated HAM Radio to the public! See <http://www.mcktech.com/wf98.htm>.

I am in my second professional career. In 92, I retired from my first career as a Submarine Commander in the Navy. I started my second career, in 92, as a sole proprietor of my own business in designing, building and deploying oceanographic buoys, which resulted from my thesis work, at NPS, and I have been busy ever since. The buoy work involved GPS/DGPS design and development along with telemetry of data using 1200, 9600 and Spread Spectrum technologies. I have developed useful products for TAPR: the ONCORE GPS Interface Board Rev 1 & 2 and with Steve, N7HPR, we developed the RTCM-104 Generator Interface Board for the ONCORE GPS.

In my career as a HAM, I strive for personal growth. Wayne Green, W2NSD/1, editor of 73 Amateur Radio Today, stated that a HAM should strive for personal growth in HAM Radio by writing HAM articles for magazines, be a club officer, run a HAMFEST and in the process, encourage others to do the same. Those are important comments. Running for BoD for TAPR is another important personal growth objective. My goals are to inspire others to expand, their HAM Radio lives, into the technologies that HAM Radio offers and TAPR is definitely in the forefront of HAM Radio Technology.

I want to be able to serve TAPR in this technology education and expansion process. I would appreciate your vote to elect me to the TAPR Board of Directors.

Barry McLarnon, VE3JF

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I've been a ham for 35 years (I can scarcely believe this myself, but the calendar doesn't lie!), and have been involved in packet radio for more than a third of that time. Like most folks, I started off doing 1200 bps AX.25, but my thoughts soon turned to using higher speeds and those interesting TCP/IP-based applications that I found on the Internet. KA9Q and WA4DSY provided the essential software and hardware building blocks, and I set out to build a 56 kbps RF MAN. It has now been in continuous operation for more than eight years. Along the way, I became a PBBS sysop (11 years continuous operation), became the national IP address coordinator, set up one of the first packet-Internet gateways, started NOS-BBS and other mailing lists, administered one of the first amateur web/mail/ftp servers, and numerous other packet-related things. And, about four years ago, I became a major Linux enthusiast!

Professionally, I am a communications systems engineer at the Communications Research Center, a federal government R&D lab. I currently work in the area of digital radio broadcasting. It may seem as if my work and hobby are rather closely related. This is true to some extent, but I do have other interests which have nothing to do with radio!

Three years ago when I first ran for the TAPR board, I said that my priorities for TAPR would be finding affordable ways to get to higher speeds, developing guidelines for effective network design (with emphasis on Level 1, i.e., the physical layer), and making more use of WWW and other Internet tools to get needed information out to the users. I think TAPR has made good progress on all of these fronts in the past three years. We have identified spread spectrum as a major enabling technology for high-speed packet operation, and there has been a surge of activity in this area. Progress has been made on the regulatory and educational fronts, a TAPR spread spectrum SIG was started, and the commercial wireless LAN offerings were studied to see what can be adapted for amateur usage. A number of experiments with the commercial hardware have been carried out, and a spread spectrum development project was launched. Information on RF propagation and other network-related issues has been made available through the Web, the SIG mailing lists and presentations at events such as the DCC and Dayton Hamvention. The TAPR Web site has become a tremendous resource for members and non-members alike.

Of course, not everyone is interested in high-speed networking. TAPR continues to be a well-rounded organization, providing good support to members in

many other interest areas, such as APRS and improvements to HF packet. I think we're headed in the right direction, and I'd like to continue to help steer TAPR down this road for the next three years.

John Ackermann, N8UR (ex-AG9V)

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I've been Vice President of TAPR, and a board member, since 1995 and I'm asking you to let me serve another term on the Board. I view TAPR as a powerful force to help advance the state of the art in Amateur Radio, and I'd like to help with that effort.

I've been a ham since 1974, and am a member of the ARRL and AMSAT in addition to TAPR. My main interest in ham radio is digital communications, and particularly networking. I've been involved in building a 19.2kbps network that covers southwestern Ohio, and help run my local club's Linux and TNOS based servers. We're also playing with some spread spectrum equipment under the TAPR STA. I was the first chairperson of the TAPR "netsig" special interest group, and I'm currently finishing a book on ham radio TCP/IP that TAPR will be publishing Real Soon Now.

Professionally, I'm a lawyer at NCR Corp. where I specialize in computer contract and intellectual property issues. Although I can't serve as TAPR's lawyer, I think that my business background can benefit TAPR.

I'd appreciate your vote for me as a TAPR Director.

Voting for the TAPR BoD

Please find the mail-in ballot on page 27. You will need to include your membership number and check number on it so that we can ensure no duplicate ballots. These numbers can be found on your mailing label. You can either vote by the ballot printed in this PSR or by electronic means using the World Wide Web.

To vote, either send in the paper ballot or access <http://www.tapr.org/elec>. You will be asked to give your membership number and check number which can be found to the right of your membership number on the mailing label of this PSR. If you have problems using the page, contact Dorothy at the office and we can look into the issue.

We look forward to your comments on this new way of collecting votes in both traditional paper and newer electronic form.

Mail-in Ballot is printed on Page 27.

TAPR 900Mhz Frequency Hopping Spread Spectrum Radio Design Meeting

The FHSS radio development group met for two in-depth design and review meetings on January 2nd and 3rd, 1998. The purpose of the meeting was to set goals for the upcoming 6-8 months. You can see some photos from the meeting at <http://www.tapr.org/tapr/html/tapr/fhss.html>.

As of the meeting, the digital board is coming to life with the CPU starting to function. The Flash memory and RAM are now being tested. Then the network interface will be checked out. When this is done, code development for the radio can really get underway. Initial code development and testing with the Motorola MC68360 will be done with a simple 8 pin BDM (Background Debugging Mode) interface described in the Motorola literature. At this time we do not have access to the more expensive tools which would reduce development time. Real progress on the project is visible with major sections of the RF board functioning and the CPU operational on the digital board.

Some of the goals regarding the CPU board include:

- CPU operational test, register verify; (Completed)
- verify BDM working; (Completed)
- RAM + FLASH testing
- Ethernet I/F working
- Develop simple stack running
 - exchanges ethernet packets
 - 360 register I/O code
 - PC display / control of 360 registers
 - PC display / control of VLSI registers
- Write PIC & 360 code, use simple stack to verify:
 - all VLSI registers can be read/written
 - 360 can talk to/from PIC
 - 360 can read/write packets via Ethernet I/F
 - 360 can talk on HDLC to Viterbi chip for data
- Modify PCB artwork and rebuild CPU board

The VCOs are now operational on the RF board and further testing of each section is underway. Some of the goals regarding the RF board include:

- Verify VCO spectral characteristics; (Completed)
- Put Motorola QPSK encoder on board, drive from PIC (temporary data)
- Add HARRIS 3724 Mod/Demod, test
- Add Tx mixer, Tx PA, T/R switch
- Add Rx down converter, IF post amp
- Loopback testing
- Turn RF board artwork

There has been a lot of discussion regarding development environment. In the short term, the group can use existing public domain development tools for the initial tests, but a more substantial compiler, assembler,

linker will be required past the initial testing. Several packages are being evaluated.

Some of the goals in the development environment tools area are to ensure the requirements list is met for the selected items:

- Assembler; C compiler (C++ preferred) with assembly source output capability, viewable as text
- Linker and Symbolic Debugger (C++)
- Means for debugger to interact with target proc.
- Runs on PC platform
- Identify Vendor
- Price the package, secure funding

Several people have inquired about what software will be developed. While the team is continuing to discuss this, no decision has to be made until we get past many of the initial issues of getting the radio operational. A first thing to work on will be the selection or the development of the kernel and an OS for the CPU, in order to help programming past the initial test phase. An important issue is to select something that will allow others interested in developing code the ability to do something. The team has examined several stacks and kernels and is currently looking seriously at XINU as the environment for the radio.

TAPR 900Mhz FHSS Project Fund Raiser

As published in the last issue of the PSR, Bob Stricklin, N5BRG, Bill Reed, WD0ETZ, Tom McDermott, N5EG, and a highly competent support group are developing the TAPR 900MHZ FHSS Radio. We figure to spend at least \$10,000 this year on the project on things like another board turn, development software, parts, and other odds and ends that a project of this magnitude requires.

TAPR will be sending out a fund raising letter in the next few months in order to help fund all or part of the \$10,000 for this year's development. We would like to ask the membership to donate money towards the development effort to ensure that we don't have to take away from other important projects that also need cash this year to be completed.

When you get the note from TAPR asking for a small contribution, please take a serious moment and help bring this unique project closer to completion. If you have contact with a regional packet organization, contact them about contributing. Help fund a project that will lead to many new and exciting operational possibilities!

Donations above \$25 will receive a certificate indicating funding of TAPR FHSS Radio Project, while donations of \$250 or more will receive a plaque to let all know of their efforts with this project. All donations are needed large and small. You can call the office at (940) 383-0000 or Fax (940) 566-2544 to make your donation by MC/Visa.

What exactly does the inside of a GPS30PC look like?

Charles A. Wells, W4OQM
W4OQM@aol.com

When Don Haselwood, W4DH, and I finally sawed the cover off my GPS-30 and I was able to see what was inside, it became apparent that it would have been nice to know what was inside before we started sawing. So, I asked Curt Erickson, N8ANA, to come over with his digital camera and take a few pictures.

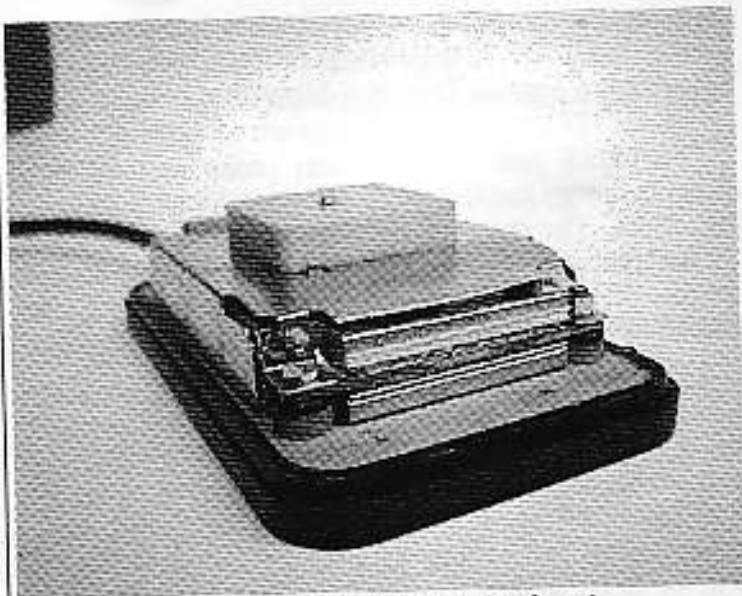


View from above and behind. Good view of patch antenna

For those of you that haven't gotten out the saw yet and for those of you who are terminally curious but don't plan to saw into it here is what it looks like. Note that these pictures were taken with the magnetic mount attached to the bottom of the base. This makes the base look a bit bigger than it really is.



Closeup view from rear (cable end)

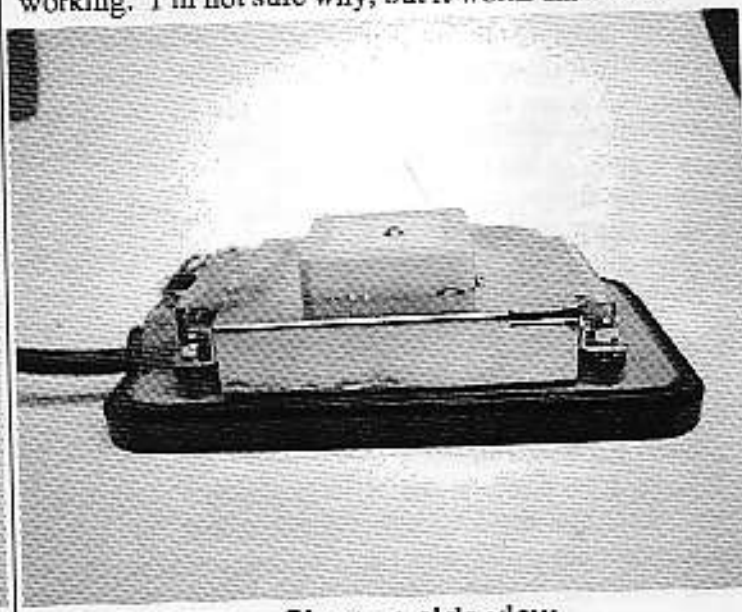


Closeup view from front

After studying the pictures, you should have a better idea of the clearances inside the housing. To remove the cover, remove all optional base plates. Then proceed as follows: Using a hacksaw, saw off a bit less than 1/8th inch (0.100 or so) from both sides and the "front end" (the end away from where the cable comes out). You can tell that you've sawed all the way through the cover when the thin strip of plastic below the saw kerf pulls away from the bottom edge.

Once all three sides have been sawed through, pry the top off with a small common screwdriver. Start at the front and work down each side. Be a bit careful that the bottom of the GPS-30 doesn't bend down. This flexing puts stress on the sheet metal shields and bends them. Once all three sides are free, the cover will lift up and break loose from the back.

At this point, you're inside. Just the act of sawing off the cover was enough to make my GPS-30 unit start working. I'm not sure why, but it works fine now.



Closeup side view

The Birth of the Internet

Vinton Cerf, as told to Bernard Aboba

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[Here is a story by Vint Cerf on the history of the Internet. As you can see from reading what Vint has to say, packet radio had a very important role in the early testing and development of the Internet as far back as 1977. I have to say that I wasn't aware that packet radio had a role at all until I read this piece. The packet radio project that SRI and Bob Kahn were working on was called SURAN. The packet radio satellite work evolved into a Silicon Valley startup company later known as Equatorial Communications. —Dwayne Hendricks]

The Birth of the Internet

In November 1972, I took up an assistant professorship post in computer science and electrical engineering at Stanford. I was one of the first Stanford acquisitions who had an interest in computer networking. Shortly after I got to Stanford, Bob Kahn told me about a project he had going with SRI International, BBN, and Collins Radio, a packet radio project. This was to get a mobile networking environment going. There was also work on a packet satellite system, which was a consequence of work that had been done at the University of Hawaii, based on the ALOHA-Net, done by Norman Abramson, Frank Kuo, and Richard Binder. It was one of the first uses of multiaccess channels. Bob Metcalfe used that idea in designing Ethernet before founding 3COM to commercialize it.

Bob Kahn described the packet radio and satellite systems, and the internet problem, which was to get host computers to communicate across multiple packet networks without knowing the network technology underneath. As a way of informally exploring this problem, I ran a series of seminars at Stanford attended by students and visitors. The students included Carl Sunshine, who is now at Aerospace Corporation running a laboratory and specializing in the area of protocol proof of correctness; Richard Karp, who wrote the first TCP code and is now president of ISDN technologies in Palo Alto. There was Judy Estrin, a founder of Bridge Communications, which merged with 3COM, and is now an officer at Network Computing Devices (NCD), which makes X display terminals. Yogen Dalal, who edited the December 1974 first TCP specification, did his thesis work with this group, and went on to work at PARC where he was one of the key designers of the Xerox Protocols. Jim Mathis, who was involved in the software of the small-scale LSI-11 implementations of the Internet

protocols, went on to SRI International and then to Apple where he did MacTCP. Darryl Rubin went on to become one of the vice presidents of Microsoft. Ron Crane handled hardware in my Stanford lab and went on to key positions at Apple. John Shoch went on to become assistant to the president of Xerox and later ran their System Development Division. Bob Metcalfe attended some of the seminars as well. Gerard Lelann was visiting from IRIA and the Cyclades/Cigale project, and has gone on to do work in distributed computing. We had Dag Belsnes from University of Oslo who did work on the correctness of protocol design; Kuninobu Tanno (from Tohoku University); and Jim Warren, who went on to found the West Coast Computer Faire. Thinking about computer networking problems has had a powerful influence on careers; many of these people have gone on to make major contributions.

The very earliest work on the TCP protocols was done at three places. The initial design work was done in my lab at Stanford. The first draft came out in the fall of 1973 for review by INWG at a meeting at University of Sussex (September 1973). A paper by Bob Kahn and me appeared in May 1974 in IEEE Transactions on Communications and the first specification of the TCP protocol was published as an Internet Experiment Note in December 1974. We began doing concurrent implementations at Stanford, BBN, and University College London. So effort at developing the Internet protocols was international from the beginning. In July 1975, the ARPANET was transferred by DARPA to the Defense Communications Agency (now the Defense Information Systems Agency) as an operational network.

About this time, military security concerns became more critical and this brought Steve Kent from BBN and Ray McFarland from DoD more deeply into the picture, along with Steve Walker, then at DARPA.

At BBN there were two other people: William Plummer and Ray Tomlinson. It was Ray who discovered that our first design lacked and needed a three-way handshake in order to distinguish the start of a new TCP connection from old random duplicate packets that showed up later from an earlier exchange. At University College London, the person in charge was Peter Kirstein. Peter had a lot of graduate and undergraduate students working in the area, using a PDP-9 machine to do the early work. They were at the far end of a satellite link to England.

Even at the beginning of this work we were faced with using satellite communications technology as well as ARPANET and packet radio. We went through four iterations of the TCP suite, the last of which came out in 1978.

The earliest demonstration of the triple network Internet was in July 1977. We had several people involved. In order to link a mobile packet radio in the Bay Area, Jim Mathis was driving a van on the San Francisco Bayshore Freeway with a packet radio system running on an LSI-11. This was connected to a gateway developed by Virginia Strazisar at BBN. Ginny was monitoring the gateway and had artificially adjusted the routing in the system. It went over the Atlantic via a point-to-point satellite link to Norway and down to London, by land line, and then back through the Atlantic Packet Satellite network (SATNET) through a Single Channel Per Carrier (SCPC) system, which had ground stations in Etam, West Virginia, Goonhilly Downs England, and Tanum, Sweden. The German and Italian sites of SATNET hadn't been hooked in yet. Ginny was responsible for gateways from packet radio to ARPANET, and from ARPANET to SATNET.

Traffic passed from the mobile unit on the Packet Radio network across the ARPANET over an internal point-to-point satellite link to University College London, and then back through the SATNET into the ARPANET again, and then across the ARPANET to the USC Information Sciences Institute to one of their DEC KA-10 (ISIC) machines. So what we were simulating was someone in a mobile battlefield environment going across a continental network, then across an intercontinental satellite network, and then back into a wireline network to a major computing resource in national headquarters. Since the Defense Department was paying for this, we were looking for demonstrations that would translate to militarily interesting scenarios. So the packets were traveling 94,000 miles round trip, as opposed to what would have been an 800-mile round trip directly on the ARPANET. We didn't lose a bit!

After that exciting demonstration, we worked very hard on finalizing the protocols. In the original design we didn't distinguish between TCP and IP; there was just TCP. In the mid-1970s, experiments were being conducted to encode voice through a packet switch, but in order to do that we had to compress the voice severely from 64 Kbps to 1800 bps. If you really worked hard to deliver every packet, to keep the voice playing out without a break, you had to put lots and lots of buffering in the system to allow sequenced reassembly after retransmissions, and you got a very unresponsive system. So Danny Cohen at ISI, who was doing a lot of work on packet voice, argued that we should find a way to deliver packets without requiring reliability. He argued it wasn't useful to retransmit a voice packet end to end. It was worse to suffer a delay of retransmission.

That line of reasoning led to separation of TCP, which guaranteed reliable delivery, from IP. So the User Datagram Protocol (UDP) was created as the

user-accessible way of using IP. And that's how the voice protocols work today, via UDP.

Late in 1978 or so, the operational military started to get interested in Internet technology. In 1979 we deployed packet radio systems at Fort Bragg, and they were used in field exercises. The satellite systems were further extended to include ground stations in Italy and Germany. Internet work continued in building more implementations of TCP/IP for systems that weren't covered. While still at DARPA, I formed an Internet Configuration Control Board chaired by David Clark from MIT to assist DARPA in the planning and execution of the evolution of the TCP/IP protocol suite. This group included many of the leading researchers who contributed to the TCP/IP development and was later transformed by my successor at DARPA, Barry Leiner, into the Internet Activities Board (and is now the Internet Architecture Board of the Internet Society). In 1980, it was decided that TCP/IP would be the preferred military protocols.

In 1982 it was decided that all the systems on the ARPANET would convert over from NCP to TCP/IP. A clever enforcement mechanism was used to encourage this. We used a Link Level Protocol on the ARPANET; NCP packets used one set of one channel numbers and TCP/IP packets used another set. So it was possible to have the ARPANET turn off NCP by rejecting packets sent on those specific channel numbers. This was used to convince people that we were serious in moving from NCP to TCP/IP. In the middle of 1982, we turned off the ability of the network to transmit NCP for one day. This caused a lot of hubbub unless you happened to be running TCP/IP. It wasn't completely convincing that we were serious, so toward the middle of fall we turned off NCP for two days; then on January 1, 1983, it was turned off permanently. The guy who handled a good deal of the logistics for this was Dan Lynch; he was computer center director of USC ISI at the time. He undertook the onerous task of scheduling, planning, and testing to get people up and running on TCP/IP. As many people know, Lynch went on to found INTEROP, which has become the premier trade show for presenting Internet technology.

In the same period there was also an intense effort to get implementations to work correctly. Jon Postel engaged in a series of Bake Offs, where implementers would shoot kamikaze packets at each other. Recently, FTP Software has reinstituted Bake Offs to ensure interoperability among modern vendor products.

This takes us up to 1983. 1983 to 1985 was a consolidation period. Internet protocols were being more widely implemented. In 1981, 3COM had come out with UNET, which was a UNIX TCP/IP product running on Ethernet. The significant growth in Internet products didn't come until 1985 or so, where we started seeing UNIX and local area networks joining up. DARPA had

invested time and energy to get BBN to build a UNIX implementation of TCP/IP and wanted that ported into the Berkeley UNIX release in v4.2. Once that happened, vendors such as Sun started using BSD as the base of commercial products.

The Internet Takes Off

By the mid-1980s there was a significant market for Internet-based products. In the 1990s we started to see commercial services showing up, a direct consequence of the NSFNet initiative, which started in 1986 as a 56 Kbps network based on LSI-11s with software developed by David Mills, who was at the University of Delaware. Mills called his NSFNet nodes Fuzzballs. The NSFNet, which was originally designed to hook supercomputers together, was quickly outstripped by demand and was overhauled for T1. IBM, Merit, and MCI did this, with IBM developing the router software. Len Bozack was the Stanford student who started Cisco Systems. His first client: Hewlett-Packard. Meanwhile Proteon had gotten started, and a number of other routing vendors had emerged. Despite having built the first gateways (now called routers), BBN didn't believe there was a market for routers, so they didn't go into competition with Wellfleet, ACC, Bridge, 3COM, Cisco, and others.

The exponential growth of the Internet began in 1986 with the NSFNet. When the NCP to TCP transition occurred in 1983 there were only a couple of hundred computers on the network. As of January 1993 there are over 1.3 million computers in the system. There were only a handful of networks back in 1983; now there are over 10,000.

In 1988 I made a conscious decision to pursue connection of the Internet to commercial electronic mail carriers. It wasn't clear that this would be acceptable from the standpoint of federal policy, but I thought that it was important to begin exploring the question. By 1990, an experimental mail relay was running at the Corporation for National Research Initiatives (CNRI) linking MCI Mail with the Internet. In the intervening two years, most commercial email carriers in the U.S. are linked to Internet and many others around the world are following suit.

In this same time period, commercial Internet service providers emerged from the collection of intermediate-level networks inspired and sponsored by the National Science Foundation as part of its NSFNet initiatives. Performance Systems International (PSI) was one of the first, spinning off from NYSERNet. UUNET Technologies formed Alternet; Advanced Network and Systems (ANS) was formed by IBM, MERIT, and MCI (with its ANSCO+RE commercial subsidiary); CERFNet was initiated by General Atomics which also runs the San Diego Supercomputer Center; JVNNet became GES,

Inc., offering commercial services; Sprint formed Sprintlink; Infonet offered Infolan service; the Swedish PTT offered SWIPNET, and comparable services were offered in the UK and Finland. The Commercial Internet eXchange was organized by commercial Internet service providers as a traffic transfer point for unrestricted service.

In 1990 a conscious effort was made to link in commercial and nonprofit information service providers, and this has also turned out to be useful. Among others, Dow Jones, Telebase, Dialog, CARL, the National Library of Medicine, and RLIN are now online.

The last few years have seen internationalization of the system and commercialization, new constituencies well outside of computer science and electrical engineering, regulatory concerns, and security concerns from businesses and out of a concern for our dependence on this as infrastructure. There are questions of pricing and privacy; all of these things are having a significant impact on the technology evolution plan, and with many different stakeholders there are many divergent views of the right way to deal with various problems. These views have to be heard and compromises worked out.

The recent rash of books about the Internet is indicative of the emerging recognition of this system as a very critical international infrastructure, and not just for the research and education community.

I was astonished to see the CCITT bring up an Internet node; the U.N. has just brought up a node, un.org; IEEE and ACM are bringing their systems up. We are well beyond critical mass now. The 1990s will continue this exponential growth phase. The other scary thing is that we are beginning to see experimentation with packet voice and packet video. I fully anticipate that an Internet TV guide will show up in the next couple of years.

I think this kind of phenomenon is going to exacerbate the need for understanding the economics of these systems and how to deal with charging for use of resources. I hesitate to speculate; currently where charges are made they are a fixed price based on the size of the access pipe. It is possible that the continuous transmission requirements of sound and video will require different charging because you are not getting statistical sharing during continuous broadcasting. In the case of multicasting, one packet is multiplied many times. Things like this weren't contemplated when the flat-rate charging algorithms were developed, so the service providers may have to reexamine their charging policies.

Concurrent with the exponential explosion in Internet use has come the recognition that there is a real community out there. The community now needs to recognize that it exists, that it has a diversity of interests, and that it has responsibilities to those who are dependent

on the continued health of the network. The Internet Society was founded in January 1992. With assistance from the Federal Networking Council, the Internet Society supports the IETF and IAB and educates the broad community by holding conferences and workshops, by proselytizing, and by making information available.

I had certain technical ambitions when this project started, but they were all oriented toward highly flexible, dynamic communication for military application, insensitive to differences in technology below the level of the routers. I have been extremely pleased with the robustness of the system and its ability to adapt to new communications technology.

One of the main goals of the project was IP on everything. Whether it is frame relay, ATM, or ISDN, it should always be possible to bring an Internet Protocol up on top of it. We've always been able to get IP to run, so the Internet has satisfied my design criteria. But I didn't have a clue that we would end up with anything like the scale of what we have now, let alone the scale that it's likely to reach by the end of the decade.

Scaling

The somewhat embarrassing thing is that the network address space is under pressure now. The original design of 1973 and 1974 contemplated a total of 256 networks. There was only one LAN at PARC, and all the other networks were regional or nationwide networks. We didn't think there would be more than 256 research networks involved. When it became clear there would be a lot of local area networks, we invented the concept of Class A, B, and C addresses. In Class C there were several million network IDs. But the problem that was not foreseen was that the routing protocols and Internet topology were not well suited for handling an extremely large number of network IDs. So people preferred to use Class B and subnetting instead. We have a rather sparsely allocated address space in the current Internet design, with Class B allocated to excess and Class A and C allocated only lightly. The lesson is that there is a complex interaction between routing protocols, topology, and scaling, and that determines what Internet routing structure will be necessary for the next ten to twenty years.

When I was chairman of the Internet Activities Board and went to the IETF and IAB to characterize the problem, it was clear that the solution had to be incrementally deployable. You can deploy something in parallel, but then how do the new and old interwork? We are seeing proposals of varying kinds to deal with the problem. Some kind of backward compatibility is highly desirable until you can't assign 32-bit address space. Translating gateways have the defect that when you're halfway through, half the community is transitioned and half isn't,

and all the traffic between the two has to go through the translating gateway and it's hard to have enough resources to do this.

It's still a little early to tell how well the alternatives will satisfy the requirements. We are also dealing not only with the scaling problem, but also with the need not to foreclose important new features, such as concepts of flows, the ability to handle multicasting, and concepts of accounting.

I think that as a community we sense varying degrees of pressure for a workable set of solutions. The people who will be most instrumental in this transition will be the vendors of routing equipment and host software, and the offerers of Internet services. It's the people who offer Internet services who have the greatest stake in assuring that Internet operation continues without loss of connectivity, since the value of their service is a function of how many places you can communicate with. The deployability of alternative solutions will determine which is the most attractive. So the transition process is very important.

Use by Other Networks

The Domain Name System (DNS) has been a key to the scaling of the Internet, allowing it to include non-Internet email systems and solving the problem of name-to-address mapping in a smooth scalable way. Paul Mockapetris deserves enormous credit for the elegant design of the DNS, on which we are still very dependent. Its primary goal was to solve the problems with the host.txt files and to get rid of centralized management. Support for Mail eXchange (MX) was added after the fact, in a second phase. Once you get a sufficient degree of connectivity, it becomes more advantageous to link to this highly connected thing and tunnel through it rather than to build a system in parallel. So BITNET, FidoNet, AppleTalk, SNA, Novell IPX, and DECnet tunneling are a consequence of the enormous connectivity of the Internet.

The Internet has become a test bed for development of other protocols. Since there was no lower level OSI infrastructure available, Marshall Rose proposed that the Internet could be used to try out X.400 and X.500. In RFC 1006, he proposed that we emulate TP0 on top of TCP, and so there was a conscious decision to help higher-level OSI protocols to be deployed in live environments before the lower-level protocols were available.

It seems likely that the Internet will continue to be the environment of choice for the deployment of new protocols and for the linking of diverse systems in the academic, government, and business sectors for the remainder of this decade and well into the next.

SPAMing on the TAPR Lists

Over the past few months, various TAPR lists have shown up on SPAM lists and thus we have had spam appear on the TAPR lists now. I wanted to share parts of a page maintained by Lsoft about SPAM. Please read it over and think about our lists when you do this. The steps listed below will help you, TAPR, and others on our lists maintain lower blood pressures and maintain a higher enjoyment of our communications.

We are working on purchasing new list software that has anti-spamming capability, but the purchase hasn't happened yet, since it requires that we have additional cash available not targeted for ongoing projects.

For the full text of the Lsoft information on spam issues, visit <http://www.lsoft.com/spamorama.html>

How to respond to a spam

If a spam gets through to your list, it will probably engender sarcastic replies (often with the spam quoted in its entirety) — and these replies will often be posted back to the list. It is therefore imperative that you make subscribers aware that when a spam occurs:

- The person responsible for the spam is probably not subscribed to the list, and thus any response back to the list will fail to reach the offender.
- An appropriate response to a spam is to forward a single copy of the spam to the person in charge of the site from which the spam originated ("POSTMASTER", "root", etc.), pointing out that the spammer is probably violating his site's appropriate use policies.
- It is inappropriate to attempt to flood the spammer's mailbox with network mail in response. This is probably in violation of your network's appropriate use policies, and it just wastes bandwidth.

Perhaps the best policy an individual subscriber can adopt toward spammers is to simply to **ignore them**, leaving the problem in the hands of list owners and newsgroup moderators, who usually have more Internet experience. If this does not work and subscribers send their complaints to the list anyway, it might be a good idea to moderate the list for a few days until the furor dies down.

Finally, we would like to propose the following guidelines for reacting to unwanted solicitation on or off your lists:

1. **DO NOT FLAME ON THE LIST!** The spammer is probably not subscribed, so you would just be adding to the noise level.

2. Remember the name of the company that sent you the ad, and make sure never to buy anything from them. Call their corporate headquarters and let them know how much you were upset by the spam. In many cases, the companies whose products are featured in the spam acted out of ignorance and genuinely did not know that this form of advertisement was not appreciated. Educating them will make the spam company lose a customer.
3. Do not bother flaming the spammer. By the time you read the spam, his account will already have been closed, assuming it isn't a bogus account to start with. At any rate, the spammer will not bother reading people's indignant replies. Spammers are usually well aware of what they are doing, and are totally indifferent to your feelings. Replying is just a waste of your time.
4. Do not flame the service provider. It is easy to say "You shouldn't be allowing people like XXXX to get an account!", but it is impossible to implement in practice. Just as L-Soft cannot do much to monitor and control how individuals use our software once they license it, it is equally difficult for an Internet service provider to control what customers do with their accounts.

Even if someone developed a psychological test that enabled service providers to detect would-be spammers in advance with 99.9% certainty, it would be a legal nightmare to put the test in operation. And it would be completely useless. All

you need to spam millions of people is a free 10-day trial diskette from any major online provider. All in all, it's absolutely impossible to run a free interchange medium like the In-

ternet without getting a number of unwanted people in the lot. There are unscrupulous people on the Internet, just as there are in the rest of the world, and there isn't much anyone can do about it, because until they speak up they're just an e-mail address like any other. The same goes with spammers.

5. Do not press the service provider for assistance in "tracing" the spammer. In most countries it would be unlawful for them to release this kind of information to you. However, the spammer probably provided a snail-mail address or phone number in his message, or some other contact point to place orders. If you really want to find out more about him, this is a good starting point, and it places you squarely in the realm of real world law, which is well understood by the judges and lawyers.
6. If you want to inconvenience the spammer in retaliation for the inconvenience you have suffered, by all means

The one way to stop spamming forever...

...is to render it ineffective by never responding to it!

do go ahead, but NOT OVER THE INTERNET! Mail-bombing the provider's Postmaster address will inconvenience the provider, not the spammer, and in most cases the provider is a victim, just like you. It's going to cost them thousands of dollars in wasted manpower just to discard all the flamage they will receive. Instead, what you should do is use the real world contact info that was provided with the advertisement. This will actually reach the spammer, because this is where he is hoping to receive the checks. Yes, it means you will have to use a real world communication medium, but that's your only option. The hard reality is that complaining over the Internet will accomplish nothing: after sending the ad, the spammer is gone from the Internet. Orders will be placed using real world methods and that is your only means of reaching the spammer from then on.

7. When accusing people or companies in public, make sure to check your facts carefully before pressing the SEND button. Remember how spamming works: the spammer abuses the computer resources and manpower of hundreds of thousands of sites worldwide to deliver his advertisement. The victims are you, us, and just about everyone on the Internet. Yes, even people whose name or hostname is mentioned in the mail header are likely to be victims; spammers have no qualms about forging mail, and even when they don't, it still doesn't mean the parties involved had knowledge of the spammer's activities and will share the profits.

So, if you have to make an assumption, it should be that the people involved in the delivery of the message are victims, just like you, except that the spam will waste even more time for them than for you. The last thing you need, when you have just spent four hours answering spam complaints from (other) victims, is to see a message where someone accuses you and/or your employer of being the master mind of organized spamming and suggests that you should be shot for the public good, or at least that someone should send the FBI to your house and have you put under arrest, with dozens of messages agreeing with the previous one or suggesting even more barbaric forms of punishment.

In fact, such messages are taken seriously by some of the people they target and may result in serious psychological trauma. They may also result in a lawyer or police officer giving you a phone call, when you did not really mean what you were typing. So far spamming has yet to result in human death; please, let's keep it this way.

Segments taken from:
<http://www.lsoft.com/spamorama.html>

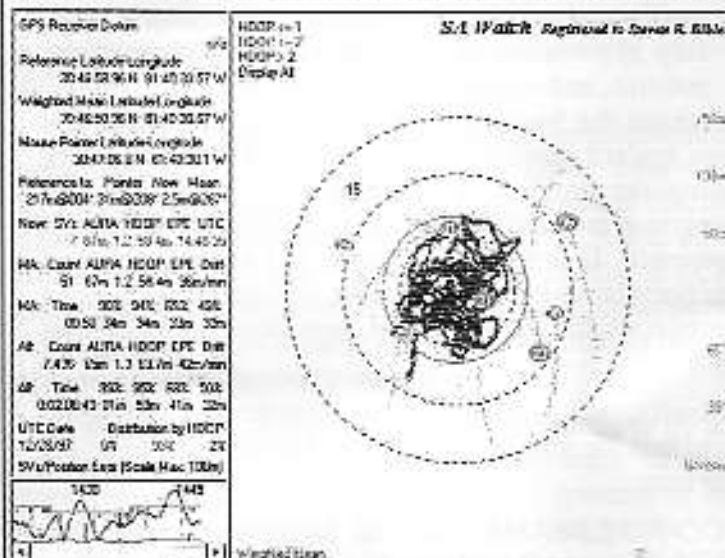
TAPR Differential GPS Reference Station Kit

Steve Bible, N7HPR

In the near future, TAPR will have available a Differential GPS Reference Station kit. If you recall, Differential GPS (DGPS) is regular GPS with differential corrections added. A DGPS Reference Station knows its exact location and using a GPS receiver determines the difference between the GPS computed position and its known location. The Reference Station then transmits these differential corrections to remote users. The remote user receives the differential corrections and sends them to a DGPS-ready GPS unit. The differential corrections signal improves the accuracy of GPS to 8 to 20 meters. The differential corrections signal of the Reference Station conforms to the RTCM SC-104 standard which many commercial GPS receivers use. Check the user's manual of your GPS receiver to determine if it is DGPS ready and how to send it differential corrections.

The TAPR GPS Reference Station kit is a daughter board (DGPSIB) that connects directly to a Motorola Oncore VP GPS receiver. The remaining equipment needed are a GPS antenna, Terminal Node Controller (TNC) and transmitter. TAPR sells separately the Oncore VP, DGPSIB, and GPS antenna. The TNC and transmitter are supplied by the custodian of the Reference Station. The differential corrections signal from the DGPSIB are sent to the TNC and then transmitted out as a AX.25 packet. The TNC is programmed with the custodian's call sign and the frequency utilized can be any amateur frequency authorized for packet communications.

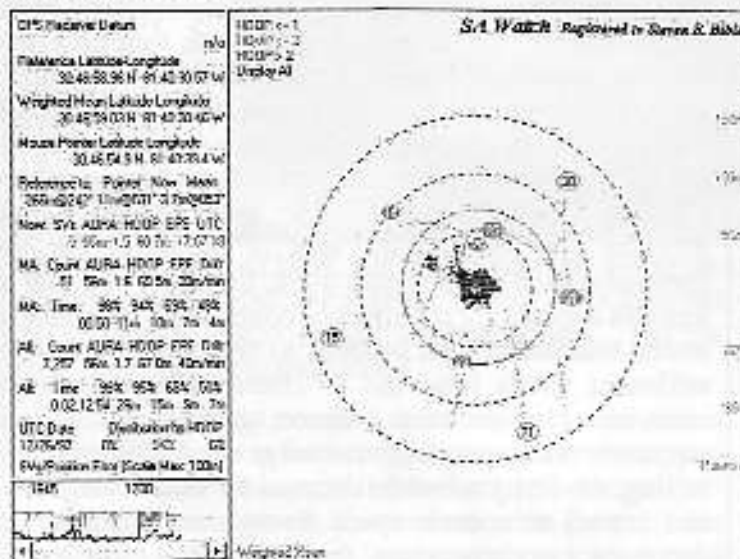
Remote users require a receiver and a TNC, no special equipment needed. The TNC output is sent to a DGPS ready receiver and depending on the make and model of



Picture 1

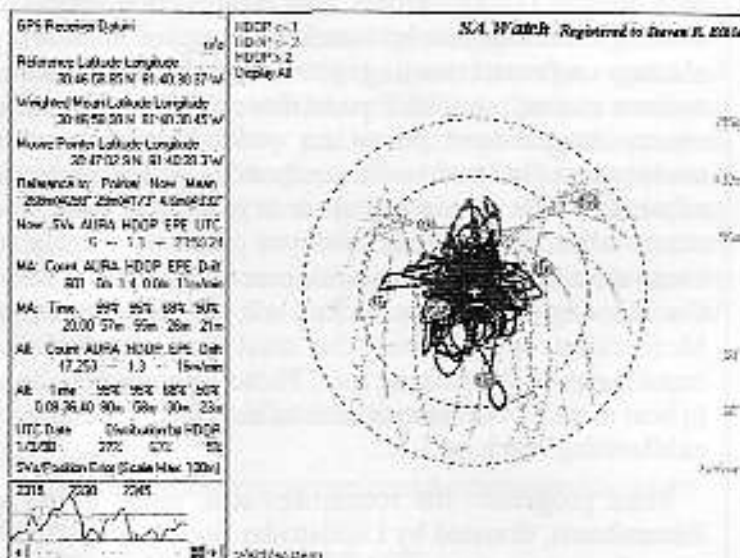
GPS receiver, it will indicate it is computing a DGPS position. Users can see graphical plots of GPS positions with and without differential corrections at <http://www.tapr.org/gps/dgps/>

Using Stan Hunting's, KFOIA, SA Watch program (<http://www.mutadv.com/kawin/pages/sawhat.htm>), you can see the difference DGPS has over civilian GPS. The following GPS receivers were held stationary and received differential corrections from the TAPR DGPS Reference Station. Two plots were made for each receiver: the first plot without differential corrections and the second with.

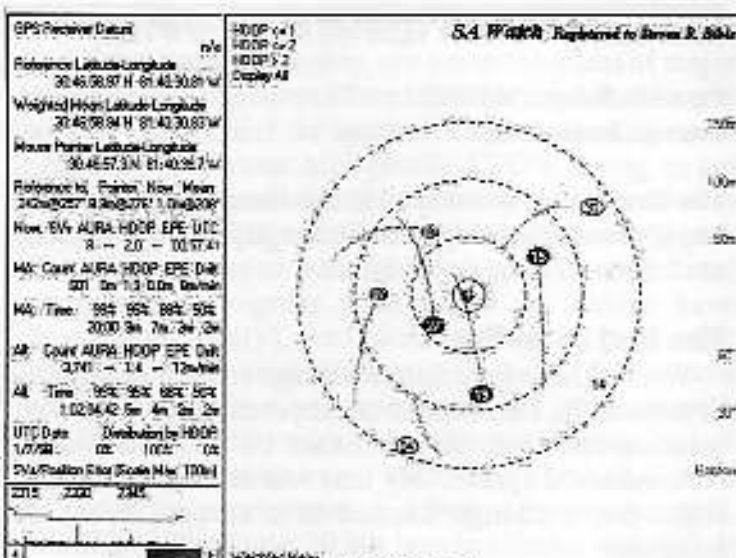


Picture 2

Picture 1 shows the Garmin GPS-20 collected without differential corrections for approximately 2 hours. SA Watch calculated the 95th percentile as 59 meters. The scale of the outer ring is 150 meters.



Picture 3



Picture 4

Picture 2 shows the Garmin GPS-20 collected with differential corrections for approximately 2 hours. The differential corrections were transmitted every 15 seconds. SA Watch calculated the 95th percentile as 15 meters. The scale of the outer ring is 150 meters.

Picture 3 shows the Motorola Oncore VP collected non-differential GPS positions for approximately 9.5 hours. SA Watch calculated the 95th percentile as 58 meters.

Picture 4 was made using a Motorola Oncore VP connected to the same antenna as the TAPR DGPS Reference Station. The RTCM output of the Reference Station was connected directly to the Oncore VP (i.e., no radio link) at a rate of one message every 10 seconds. Positions were collected for 2 hours. SA Watch calculated the 95th percentile at 4 meters. The scale of the outer ring is 150 meters.

Look toward <http://www.tapr.org/gps/dgps/> and the TAPR home page for an official announcement of the TAPR DGPS Reference Station kit.

APRS QSY Update

Since the last PSR, the TAPR APRS SIG has begun the collection of data for a potential APRS QSY fund. The poll is also serving as a straw poll of the sentiment behind this issue. All APRS users are encouraged to participate. If you have not submitted your information yet, please take a moment and make your thoughts known about the issue. The questionnaire can be filled out on-line at <http://www.tapr.org/aprsqsy>. If you need a survey, just contact the TAPR office.

If you are not familiar with what is happening, a full writeup with views in favor and against can be found on the APRSQSY web page <http://www.tapr.org/aprsqsy>. To be perfectly clear...no decision to move has been made. This is information gathering so as to gauge the sentiments within APRS community and the money that might be required for the proposed QSY fund. All questionnaire responses are available on-line at the aprsqsy web page.

Microship Status 12/31/97 (Issue #122)

Steven K. Roberts, N4RVE
Nomadic Research Labs

The four photos referenced in this issue may be found at: http://www.microship.com/Latest_Update/newpix.html until the next issue is published.

The End of an Era

Wooo. Three frenetic months ago (oops!) at the close of issue #121, I mentioned the impending move from our windowless lab in the heart of Silicon Valley tech-industrial sprawl. My tone was at once nervous and flip... major change loomed in a shape I could not imagine.

Well, it happened. As the end of the lease drew nigh, our world became a bizarre bifurcated reality of fiberglassing and boxing — Bob Stuart's creative efforts yielding ever more interesting results even as the workspace collapsed around him and his intrepid apprentice, Lisa.

"Where are those neoprene strips you found?" asks Bob, looking to design the gasket interface on the console cowling.

"Ah, just a second." I scan the moving inventory, already cataloging the contents of over 200 boxes, find the reference to L-13 (a plum of a dumpster-diving prize, if I do say so myself), and after a few moments' scurrying slit the tape, tease out a few strips, and thread my way between packed piles and the Zone of Goo to pass them to Bob.

Work continued in this convoluted fashion until the twin mega U-Haul fuel guzzlers rumbled into the parking lot and cozied up next to the Mothership, their gaping maws all in a row, ramps lolling like tongues, hungry for boxes and lab furniture. In an epic weekend, we optimized packing density to the point of exceeding GVWR specs, then hit the road... a convoy of three trucks and two trailers held together by GMRS radio, with 26 wheels on the ground and an aggregate fuel economy of 2.5 miles per gallon. Bob Stuart and Mike Gittelsohn piloted the trucks; I drove the Mothership with Lisa in cargo-mode (still not licensed to drive in the U.S.) — northbound like madmen to Washington at the beginning of winter.

After a nightmarish and bloody day of shoehorning the whole mess into 4,000 cubic feet of storage space north of Bellingham, Mike returned to California and Bob to Salt Spring Island... leaving us to find a building so we can move it all again — this time, presumably, into a permanent Nomadic Research Labs home base. (In addition to the heroic Bob and Mike, who not only loaded

and unloaded but drove through 1,000 miles of rain and I-5 torpor, a big THANK YOU goes to the other folks who helped us pack tons of equipment onto the trucks: David Berkstresser, Randy Devol, Andrew Letton, Mark Moorcroft, and Dwayne Hendricks.)

Beauty Emerging

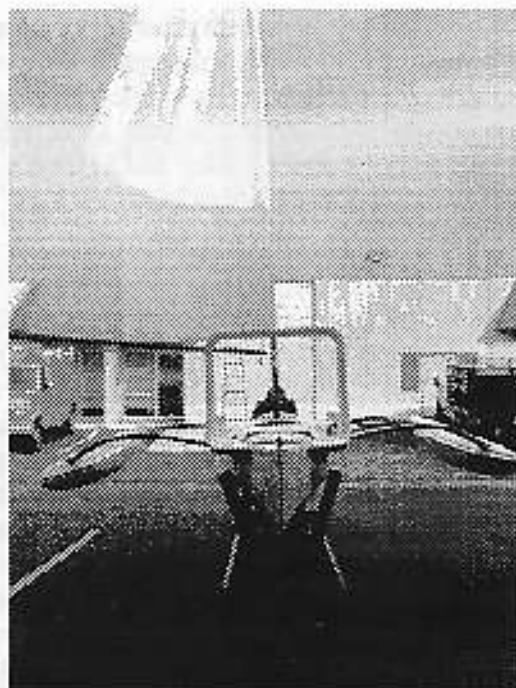
The first of the Microships, meanwhile, has reached completion of the raw fiberglass fabrication phase... take a look at the photos to see what a canoc can become when shaped by bizarrely intertwined design goals!

The first clue that glassing was nearing an end lay in the brainstorming. As moving deadline enforced more and more dedicated activity, conversation took on a new flavor: cowling design, control line management, anchoring options, conversion into sleep mode, pedal drive access, electric thruster deployment, and so on — the focus now on applications and fixtures instead of raw shape and marine architecture. One of Bob's final projects was slotting the turn of the bilge for the forward-angled daggerboard trunk, the result of hours of analysis concerning the effect of board depth on center of lateral resistance, what happens to center of effort when stiffening winds bend the 19' freestanding aluminum mast and change helm balance, grounding-induced automatic retraction, dagger stowage when running or not sailing, the layup schedule dictated by worst-case loads, and impact on console space. Every time such a set of decisions was cast in glass, the design grew more stable, the choices ahead more and more constrained and focused on single issues. Odd that the evolution of the design was as much retrospective as proactive... like sailing in the fog, the end wasn't in sight until it was fast upon us.

Yes, one of the graceful Wenonah canocs has morphed into a trimaran, the Kevlar hull flowing into Divinycell-core decks complete with fore and aft hatches with integral D-ring fixtures, bow cleat, Teflon-anodized rotating mast base, cockpit enclosure, angled solar array mating surfaces, cowling interface, aka nests, stern antenna mount, retractable pedal drive nacelle with access cover, integral hard points for pedal bearings, and a sculpted radar arch with embedded traveler track substrate. The whole gestalt is organic and fluid, the curves alluring, the boat solid yet graceful, a study in stress distribution blended with practicality and artistry. On the day before we tucked all six hulls into the Mothership, we stepped the mast and attached the crossbeams in the parking lot... Photo 1 shows her about to beat to windward across Silicon Valley followed by an exhilarating reach up I-5...

More progress: the recumbent seat, made by Ryan Recumbents, donated by Landstrider Sports Trikes (cool recumbent tricycles), and black-anodized by CSL, is ready to be mounted — with a triangulated back-support

structure that allows a wide adjustment range along with a forward coaming-support that lets the seat pivot out of the way for passage into sleep mode or access to the power bay. **M o o r e** Sailboats created a pair of elegant lightweight carbon fiber rudders, color-matched to our hulls, and we are now designing the deployment and mounting system. (These sleek foils put the heavy used Nacra daggerboards to shame... but the trunk is designed around them.)



I'm also delighted to report that the quest for wheels is at an end: the folks at Seitech Launching Dollies shipped us eight of their amazingly lightweight 16" diameter, 4" wide pneumatic tires on plastic rims with Delrin roller bearings — the best solution we've found to a non-corrodible wheel that can handle both pavement and mushy stuff. All we need is a hinged strut assembly and associated control lines, and she's ready to roll. And I found an Ankarolina on the clearance table at West Marine: 115' of 3,500-pound test nylon webbing (1" wide) that will mount on the foredeck and keep the anchor line under control. Much more on all this, of course, as it becomes integrated into these wee boats...

Indeed, integration is now becoming the major issue: packaging, weight budget, gear stowage, and line management. Microships are TINY — the only enclosed stowage areas are bow and stern compartments accessed by gasketed deck hatches. There's a little space around the seat, and a few stowage pockets here and there, but basically, now that we have had plenty of time to stare at this, it is clear we are dealing with on-board equipment inventory on the scale of bicycle touring, not coastal cruising.

Links for this section

Landstrider: <http://ourworld.compuserve.com/homepages/ttank/strider.htm>
 Seitech: <http://www.seitech.com>
 Moore Sailboats: phoneto:408-763-0196

From Wheel Estate to Real Estate

All that notwithstanding, we are in the midst of major disruption — the Santa Clara lab is history. For months we were on a quest for sponsored space, sending email proposals to various high-profile CEO's, trying to get past the bureaucratic barriers to occupying one of over 150 empty buildings at the former Fort Ord site (now a Cal State campus with a healthy environmental engineering program with which we would have dovetailed nicely), and schmoozing various other universities and smaller firms. No luck. We're now renting a room from which to launch the lab quest, with a full-scale electronics lab, fiberglass shop, small publishing business, two kayaks and two Microships-in-progress, a dozen or so computers, BEHEMOTH, about 20 lab benches/desks, and 350 or so boxes of STUFF... all in cold storage.

It all started about 3 months ago. With the clock relentlessly ticking and Bob working alone in the lab, Lisa and I drove to Washington (we can't even fantasize about real estate near Silicon Valley), stopping enroute to check out potentially interesting sites in Northern California and along the Columbia River. One of the latter was particularly amusing — 10,000 square feet of ancient creamery in Gray's River, WA: a huge riverfront building for only \$69K! The catch, of course, is that it's on a flood plain and gets about 3-4 feet deep once a year, but hey... on that day we could enjoy the luxury of an indoor launch ramp.

We did the real-estate tour on a grand yet hurried scale, home-basing with endlessly delightful old friends on Bainbridge Island and making daily pilgrimages to Whidbey Island, Port Townsend, Port Angeles, Bellingham, and anywhere else that sounded promising. The objective: at least 2,500 square feet of shop building within a walkable mile of a launch site, along with a house that can be rented out to more or less cover the mortgage, providing a long-term home base for this project that will at last eliminate these biennial panic-quests for donated space.

Our first lesson is that in the real estate business, non-quantitative terms have no meaning. We drove excitedly to Quilcene Bay one morning to find a "huge shop" that was a slightly oversized 2-car garage with a dusty workbench along the back wall. "Close to the beach" might apply if you are driving the family car, but not if you are dragging a 600-pound Microship behind your body for a quick test sail. And we learned to be suspicious of lines like "peek-a-boo water view," "ultimate fixer-upper," and "open-minded buyers will be intrigued by this unique property."

One place that was close to meeting spec. sold to a horse family while we were pondering it, and then we ran out of time... zooming back down that all-too-familiar I-5

with a side trip to Cameron Park for Lisa's first experience in a small plane... Brian Lloyd's 1949 Piper Clipper. We soared out over Gold Country (American River and Placerville), Lisa wide-eyed and delighted by every moment. "I think I'll skip getting my U.S. Driver's License," she said after running an avian circle in the parking lot with arms outstretched childlike, "and go directly to becoming a pilot."

Uh-ohhhh...

Intrigued by a few calls from realtors over the next week, I turned around and jetted back north alone, this time hot on the trail of a perfect spot — 3,600 sq. ft. of shop a mile from a launch ramp on Birch Bay, with a very rentable house... all on 5 acres for \$160K (about \$1 million in Silicon Valley real estate dollars). Two visits, lots of video, hours of research... and then the dark truth emerged: the pristine vast empty land across the street, stretching all the way to Cherry Point, is zoned Heavy Industrial and slated for development by Trillium Corporation as a deep-water tanker port... with "my" quiet country road the main truck route into the complex. sigh

I'll spare you the details of the rest of our search to date — but it's beginning to look like the ideal solution is house and land on which we can have a metal building erected... it's surprisingly inexpensive and is guaranteed to meet my needs (though there is this ultimate fixer-upper on waterfront up in Blaine that keeps teasing through our thoughts, the huge shipyard building a liability to anyone sane, but endlessly enchanting to an "open-minded buyer").

Damn. Last time I bought a house it inspired a long-distance bicycle adventure...

I should mention, by the way, that the move from Silicon Valley was not merely a financial one. For a wcc-boat sailor and kayaker, the water in the Pacific Northwest is rich with promise and intrigue; San Francisco Bay, despite its legendary beauty and stimulating conditions, is nowhere near as open to camping-scale gunkholing as Puget Sound, the San Juans, and the Gulf Islands. Also, the culture has changed over the past decade... though the Valley is still the ultimate refuge of geekdom and a techno-resource mecca, it has become more busy and less playful than it once was. It's a subtle difference from year to year, and prone to subjectivity, but the Valley has matured and grown serious, trafficking in commodities, busy with startups, collectively tied down by the velvet handcuffs of stock options and buyouts. It no longer feels like a manic grown-up science fair fueled by exuberance, tinged with New Age silliness, and rewarded by surprise riches that barely distract the True Hacker from the endless quest for new limitations to conquer.

So while we will miss Halted, easy access to both surplus and cutting-edge gizmology, and a few brilliant friends, we're actually excited to be up here in this chilly aquatic wonderland where spontaneous smiles on the street are commonplace and at least a few people still see computers as a labor of love (and no, I'm not talking about Redmond!).

Oh, and speaking of computers...

First Packnet Hacks

This is almost fading into the vapors of memory with all the recent adventures in boat fabrication and lifestyle disruption, but we've been refining the spec for the "low-level network" that connects backpacks and on-board control systems. Something has to be alive all the time to handle watchdog polling, security, location tracking, environmental data collection, power monitoring, and other basic functions — without drawing the amps needed by high-speed wireless links, ethernet hub, and high-level systems with their disks merrily a-spinning. It turns out that vanilla ham-radio packet links in the 70cm band are just about ideal — all the applications-level stuff and business traffic can be handled by the Macs under FCC Part 15 while this amateur "packnet" takes care of the toys. (Oh yes... my sweetie just received her Tech license recently... meet KF6NWO, a callsign rich with apropos acronyms.)

Under the present design, each backpack carries a packet TNC and one of the little Motorola GPS receivers, interfaced by a Mic-E from TAPR. This is a small and easily-waterproofed package, capable of coexisting unobtrusively with our person-to-person voice operation while tailing each transmission with a GPS fix along with various flags (if we're not chatting, the data is sent in short bursts every few minutes). My boat collects all this from each pack as well as Lisa's boat — allowing a one-button query from any remote to receive a calculated great-circle distance and bearing to any other node as well as basic system status update (delivered via speech synthesizer). And, of course, it becomes possible to remotely power-up the big iron and fast network to allow full control, email, web access, video, or system hackage via the wireless graphic front end.

One of the puzzles that remained was the precise architecture of Lisa's control node in the context of my multidrop FORTH network, and it turned out to be simple in theory: just hang a PacComm TNC on the node's console port. As usual, this took quite a bit of fiddling with handshake and flow control options, but finally worked... I could sit at my Mac, connected to a KAM+ and the Icom mobile dual-bander out of my truck via the serial crossbar, and hack FORTH on a battery-powered New Micros board linked to an old HT at the other end of

the lab. This proof-of-concept complete, I went no further... back to boat-fabrication and move-planning.

By the way, I mentioned in #121 that PBA offered an RS-232 interface to the Dallas Semiconductor MicroLAN hardware... it has arrived! I'm looking forward to unpacking it and putting it to use... note their direct URL below, different from the one I posted before.

Links for this section

PBA: <http://pages.infinite.net/pba>

TAPR MIC-E:

<http://www.tapr.org/tapr/html/mic-e.html>

Hogfish Reprise

We recently experienced an interesting bit of "closure" in another domain... beloved Hogfish, now more aptly named Pelican, is afloat and sailing gracefully. Lisa and I joined the new owners for a spin on the Oakland Estuary a few weeks ago, and the only comparison I can muster that accurately captures the emotional impact of that event is watching a beautiful ex-lover aglow in the company of her new mate. Pelican's new owners finished the rig with our parts, built the pivoting centerboard trunk, added tramps and a basic suite of cruising accommodations, replaced the rustbucket trailer, and are now presumably somewhere in or near San Diego. tremulous sigh Light of helm, fast on her feet, this lovely 30-foot folding trimaran has at last spread her wings and escaped a decade of storage yards and industrial buildings.

But I still think it was the right decision: these wheeled multimodal micro- tris are right for us. They're small enough to make every sail an adventure, yet just large enough to contain all essential life-support... light enough to haul out with muscle, yet solid enough to see the world... simple enough to be as accessible to strangers as a bicycle, yet insanely complex in that exquisite way that only a True Geek can relish. Pelican, for all her elegance and historical uniqueness, was too much like a yacht for me, even if it did take a year or so for the realization to sink in!

And so, we embark on a new era, somewhere in the Pacific Northwest, establishing a long-term home base from which to wander aboard these tiny networked boats. Lots of new developments are brewing (but a bit too early to publish), and we're just at the point of forking the project into two parallel threads: the long-awaited console fabrication process now has the green light to proceed since the physical constraints of the boat are at last defined. Once we find a place to plug in the soldering iron, that is...

Cheers and Happy New Year from Nomadic Research Labs!

— Steve & Lisa

PSK31: an HF Keyboard to Keyboard Mode

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Background: The PSK31 Philosophy

PSK31 is the result of my belief that the present batch of "data" modes have left a gap in amateur radio operating, the gap that was previously filled by AMTOR or even traditional RTTY, in which two or more operators chat to each other on an open channel. Modes such as packet radio, Pactor, and others, are highly complex, are unsuited to multiway conversations, and in particular, the long block lengths introduce an unacceptable delay in the processing of text such that even normal conversation is unpleasant and quick-break question/answer sessions are impossible. The move to automated unattended message forwarding has left a gap in the person-to-person communication field, and PSK31 is an attempt to remedy this situation with a simple but efficient code structure coupled with the narrowest possible bandwidth, and with only enough error-correction to match typical typing-error rates, and with no time-consuming synchronisation, changover, and ARQ processes.

The 31 baud BPSK modulation system used in PSK31 was introduced by SP9VRC in his SLOWBPSK program written for the Motorola EVM. Instead of the traditional frequency-shift keying, the information is transmitted by patterns of polarity-reversals (sometimes called 180-degree phase shifts). This process can be thought of as equivalent to sending information by swapping-over the two wires to the antenna, although, of course, the keying is more usually done back in the audio input into the transceiver. A well-designed PSK system will give better results than the conventional FSK systems that amateurs have been using for years, and is potentially capable of operation in much narrower bandwidths than FSK. The 31 baud data rate was chosen so that the system will just handle hand-sent typed text easily.

There is a problem with PSK keying which doesn't show up with FSK, and that is the effect of key-clicks. We can get away with hard FSK keying at moderate baudrates without generating too much splatter, but polarity reversals are equivalent to simultaneous switching-off of one transmitter and switching-on of another one in antiphase: the result being keyclicks that are TWICE AS BAD as on-off keying, all other things being equal. So if

we use computer logic to key a BPSK modulator such as an exclusive-or gate, at 31 baud, the emission would be extremely broad. In fact it would be about 3 times the baudrate wide at 10dB down, 5 times at 14dB down, 7 times at 17dB down, and so on (the squarewave Fourier series in fact)

The solution is to filter the output, or to shape the envelope amplitude of each bit which amounts to the same thing. In PSK31, a cosine shape is used. To see what this does to the waveform and the spectrum, consider transmitting a sequence of continuous polarity-reversals at 31 baud. With cosine shaping, the envelope ends up looking like full-wave rectified 31Hz AC. This not only looks like a two-tone test signal, it IS a two-tone test signal, and the spectrum consists of two pure tones at $\pm 15\text{Hz}$ from the centre, and no splatter. Like the two-tone and unlike FSK, however, if we pass this through a transmitter, we get intermodulation products if it is not linear, so we DO need to be careful not to overdrive the audio. However, even the worst linears will give third-order products of 25dB at $\pm 47\text{Hz}$ (3 times the baudrate wide) and fifth-order products of 35dB at $\pm 78\text{Hz}$ (5 times the baudrate wide), a considerable improvement over the hard-keying case. If we infinitely overdrive the linear, we are back to the same levels as the hard-keyed system.

There is a similar line of reasoning on the receive side. The equivalent to "hard-keying" on the receive side is a BPSK receiver which opens a gate at the start of a bit, collects and stores all the received signal and noise during the bit, and then "snaps" the gate shut at the end. This process gives rise to the receive-side equivalent of key-clicks, namely sidelobes on the receiver passband. So, although this "integrate-and-dump" method is 100% efficient in the task of sorting out signal from noise, it will only reject signals by 10dB at 3 times the baudrate wide and so on, the same spurious rejection figures that we got as spurious emission figures for the transmit side. The PSK31 receiver overcomes this by filtering the receive signal, or by what amounts to the same thing, shaping the envelope of the received bit. The shape is more complex than the cosine shape used in the transmitter: if we used a cosine in the receiver we end up with some signal from one received bit "spreading" into the next bit, an inevitable result of cascading two filters which are each already "spread" by one bit. The more complex shape in the receiver overcomes this by shaping 4 bits at a time and compensating for this intersymbol interference, but the end result is a passband that is at least 64dB down at $\pm 31\text{Hz}$ and beyond, and doesn't introduce any inter-symbol-interference when receiving a cosine-shaped transmission.

Note that the transmitter and receiver filters have to be "matched" to each other for the ISI performance to be right. Some systems like this use a pair of identical receive and transmit filters which are matched. If I did this and someone else came along wanting to improve the performance, they would have to get everyone else to change their transmit filters. I have therefore chosen to use the simple cosine shape for the transmitter and match that in the receiver. This leaves the way open for others to develop better receivers without new transmitters being incompatible with old. This is slightly different from the SP9VRC approach.

To summarize: PSK31 has been designed not only to give all the weak-signal-in-white-noise advantages that PSK has to offer, but to go further and optimize the performance in the presence of other signals, to reject them on receive and not to interfere with them on transmit. PSK31 is therefore ideally suited to HF use, and would not be expected to show any advantage over the hard-keyed integrate-and-dump method in areas where the only thing we are fighting is white noise and we don't need to worry about interference.

A separate issue is the one of information coding. This is covered fully in the article following this one.

The QPSK Mode

In December 1997, PSK31 introduced the QPSK mode. In this mode, instead of just keying by phase reversals, that is, 180-degree phase-shift, an additional pair of 90 and 270 degree phase-shifts are possible. If you thought of BPSK as reversing the polarity of the signal, then QPSK can be thought of as two BPSK transmitters on the same frequency but 90 degrees out of phase with each other. By thinking of the receiver as being two BPSK demodulators at 90 degrees, we have two channels sharing the same frequency, but of course, with only half the transmitter power in each. We therefore have twice the bit-rate but at 3dB less signal-to-noise ratio. We could use this feature to transmit data at twice the speed with 3dB less noise margin.

The PSK31 philosophy is to stay at the speed needed to handle hand-keyed text, so why do we consider QPSK at all? The answer is that we can use the extra capacity to reduce the error-rate while keeping the bandwidth and the traffic speed the same. Note that because we have a 3dB SNR penalty with QPSK, any error-correction scheme we introduce has to be at least good enough to correct the extra errors which result from the 3dB SNR penalty, and preferably a lot more, or it will not be worth doing. By doing simulations in a computer, and tests on the

bench with a noise generator, it has been found that when the bit error-rate is less than 1% with BPSK, it is much better than 1% with QPSK and error-reduction, but when the BER is worse than 1% on BPSK, the QPSK mode is actually worse than BPSK. Therefore, if we are dealing with radio paths where the signal is just simply very noisy, there is actually no advantage to QPSK at all!

However, all the tests we have done on the air show that QPSK with the chosen error-reduction scheme is better than BPSK, except where we have deliberately attenuated the signal to make it artificially weak. Typical radio circuits are far from being non-fading with white noise. Typical radio paths have errors in bursts rather than randomly spread, and error-reduction schemes can give useful benefits in this situation in a way that cannot be achieved by anything we can do in the linear part of the signal path. With the code used in PSK31, a 5:1 improvement is typical, but it does depend on the kind of path being used. For this reason it is worth keeping both modes available and remembering that there may be times when one mode works better than the other and others when the reverse will be the case.

When comparing PSK31 with other modes, remember that the switch between "straight" and "error-corrected" modes in PSK31 is done with both the bandwidth and the data-rate remaining the same. In most other systems that can switch, either the bandwidth or the data rate changes when the system switches, and the figures for error-rate improvement can be misleading unless they are carefully compared.

The error-reduction code chosen is one of a type known as convolutional codes. The code systems used in the past have been block codes, where each character is a fixed-length code, and a fixed number of extra bits are added to make a longer block, and this longer block is capable of correcting errors within itself. These extended blocks are then transmitted as a serial bitstream. In a convolutional code, the characters are converted to a bitstream and then this bitstream is itself processed to add the error-reduction qualities. There is no relationship between the boundaries between characters and the error-reduction process. Since the channel errors are also not related in any way to the character boundaries, convolutional codes are better suited to serial links than block codes, which were originally designed for protecting errors in memory banks and similar structures.

It is not quite correct to refer to the convolutional code system as "error-correcting", since the raw data is not actually transmitted in its original form and therefore it makes no sense to talk about it being corrupted by the link and corrected in the decoder. In

PSK31, the raw data is transformed from binary (1 of 2) to quaternary (1 of 4) in such a way that there is a precisely known pattern in the sequence of quaternary symbols. In the code used in PSK31, the pattern of quaternary symbols is derived from a run of 5 consecutive data bits. For example, if we label the four phase-shifts as A, B, C, and D, and suppose that the transmitter sends continuous A's when the raw data stream is sending continuous 0's. Because the convolutional encoder works on a run of five bits, when the data stream sends ..000010000..., the transmitter actually sends ...AAAADCCBDAAAA..., that is, each binary bit to be transmitted results in a unique 5-symbol sequence, overlapping with these sequences from adjacent bits, in a predictable way which the receiver can use to estimate the correct sequence even in the presence of corruptions in parts of the sequence.

The decoder, known as a Viterbi decoder after the man who thought of it, is not really a decoder at all, but a whole bank of parallel encoders, each fed with one possible "guess" at the transmitted data sequence. The outputs of these parallel encoders are all compared with the received symbol-stream. Each time a new symbol is received, the encoders need to add an extra bit to their sequence guesses and consider that the new bit might be a 0 or a 1. This doubles the number of sequence guesses, but a clever technique allows half of all the guessed sequences to be discarded as being less likely than the other half, and this means that the number of guesses being tracked stays constant. After a large number of symbols have been received, the chances of a wrong guess at the first symbol tends to zero, so the decoder can be pretty sure that the first bit was right and it can be fed to the output. In practice this means that the decoder always outputs decoded data bits some time after they have been received. This delay in PSK31 is 20 bits (640ms) which is long enough to make sure that the decoder has done a good job, but not so long that it introduces an unacceptable delay in displaying the received text.

The source code which you may have with this distribution is freeware, provided it is used only for amateur purposes. If you have suggestions for improvements, or you find bugs, please report them back to me and do not broadcast your own modifications or bug-fixes.

Actually there are at least 2 implementations based on DSP evaluation modules from Motorola (EVM56002DSP) by Peter Martinez G3PLX and Texas Instruments (C50DSK) by Andrew Senior G0TJZ. Both versions are available from:
<http://bipt106.bi.chu.cs/psk31.html>

Description of the Variable-Length Coding used in PSK31

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The normal asynchronous ASCII coding used on the original version of this system by SP9VRC, and indeed the asynchronous system used for transmission of RTTY for the last 50 years, uses one start-bit, a fixed number of data-bits, and one or more stop-bits. The start-bit is always the opposite polarity to that of the stop-bit. When no traffic is being sent the signal sits in stop polarity. This enables the receiver to start decoding as it receives the edge between the stop-signal and the start-bit, and drop back to idle when the stop bit arrives.

One disadvantage of this process is that if, during a long run of traffic, an error occurs in either a stop-bit or a start-bit, the receiver will lose synchronisation, and may take some time to get back into sync, depending on the pattern of following characters: in some situations of repeated characters the receiver can even stay in a false sync, for as long as the repeated character pattern persists.

The code used in PSK31 overcomes this problem by signalling the gap between one character and the next, not by means of the stop-start sequence which can occur in the middle of a character, but by designing the code carefully so that the sequence which marks the boundary between characters can never be mimicked inside a character. There can therefore never be a cascade of errors if the code loses synchronisation. This idea also has another advantage, in that the character-codes no longer need to be a fixed length. If, as in normal amateur radio contacts, the traffic being sent consists of plain language, there are some characters which occur more often than others and there are some which may hardly ever be used. In morse code this is used to advantage by using short codes for the common letters and longer codes for less-common ones. In such a variable-length code, the average character rate is faster than in a code where all the characters are the same length. Or, stated in a different way, a variable-length code can be transmitted at a lower bit-rate, and therefore a lower bandwidth, and hence suffer less errors. The code used in PSK, called Varicode, works like this:

1. All characters are separated from each other by two consecutive 0 bits.
2. No character contains more than one consecutive 0 bit.

In the same way that it is obvious that all morse-code characters begin and end with a "keydown" element, all characters in Varicode must begin and end with a 1, and the "00" between characters is equivalent to the letterspace in morsecode.

With such a code, the receiver detects the end of one code and the beginning of the next by detecting the occurrence of a 00 pattern, and since this pattern never occurs inside a character, the "loss of sync" problem that gives trouble with asynchronous systems can never occur.

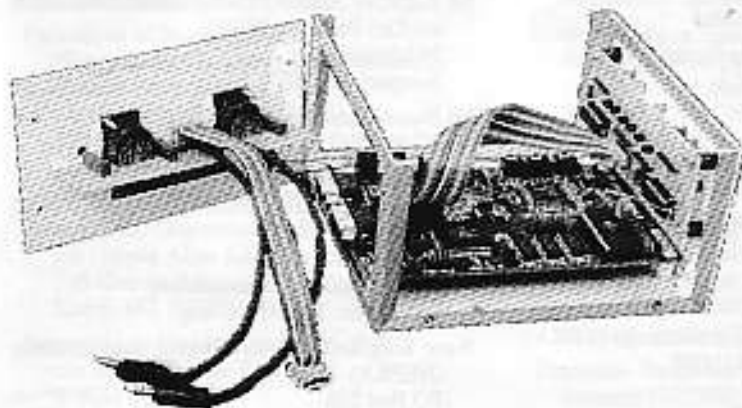
The variable-length coding used in PSK31 was chosen by collecting a large volume of English language ASCII text files and analysing them to establish the occurrence-frequency of each of the 128 ASCII characters. Next a list was made of all the binary patterns that meet the above rules, namely that each pattern must start and end with a 1, and must not contain more than 1 zero in a row. This list was generated by computer, starting at the shortest. The list was stopped when 128 patterns had been found. Next the list of ASCII codes, in occurrence-frequency order was matched to the list of binary patterns, in length order, so that the most frequently-occurring ASCII codes were matched to the shortest patterns. To see how well this would perform, a simple calculation was made to predict the average number of bits in typical plain language text transmitted by this code, taking into account the 00 gap between characters. The result was between 6 and 7 bits per character. This compares very favourably with 9 bits per character for the asynchronous system. The shortest character is the "space code", transmitted as a single 1. The longest is 10 bits long, or rather 12 bits since we must include the 00 separator.

In order to make sure that the receiver can regenerate the symbol timing, the logic zero state in Varicode is mapped to the "polarity reversal" state in the BPSK and QPSK modulation. In this way, when idling, there is a continuous modulation of the carrier and this amplitude modulation at the bit-rate is used in the receiver to keep in sync. The worst-case is transmission of a repeated "I" character in BPSK mode, where there will be a 9-bit period of unmodulated carrier followed by two reversals. This is enough to keep the receiver in sync, and in any case this is not a common character! In BPSK, every reversal gives a little boost to the bit-sync process. In QPSK, even the +90 and -90 degree phase-shifts contain some amplitude modulation and there are no characters with long runs of 1's.

The actual alphabet is given in the file ALPHABET.DAT, which is a plain text file giving the varicode pattern as 0's and 1's, one per line, in ascending order of ASCII code. The PSK31 software is available on the web at: <http://bip106.bi.chu.es/psk31.html>.

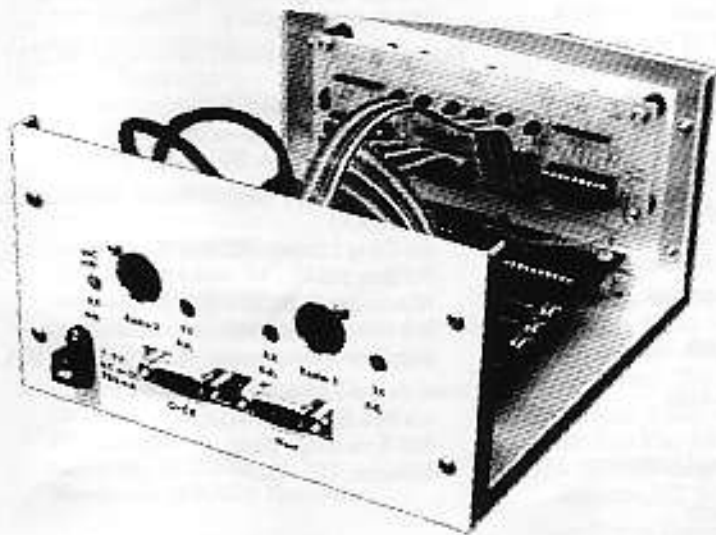
TAPR EVM56002 Interface Boards and Enclosure Kit

TAPR will be releasing an interface kit for the Motorola EVM56002 DSP evaluation board. This will be followed with an enclosure kit sometime in the Spring. The interface kit has been discussed for about a year, with a group coming forward late in 1997 to complete the design process. At this time, four units are being tested and the enclosure is being prepared for manufacturing.

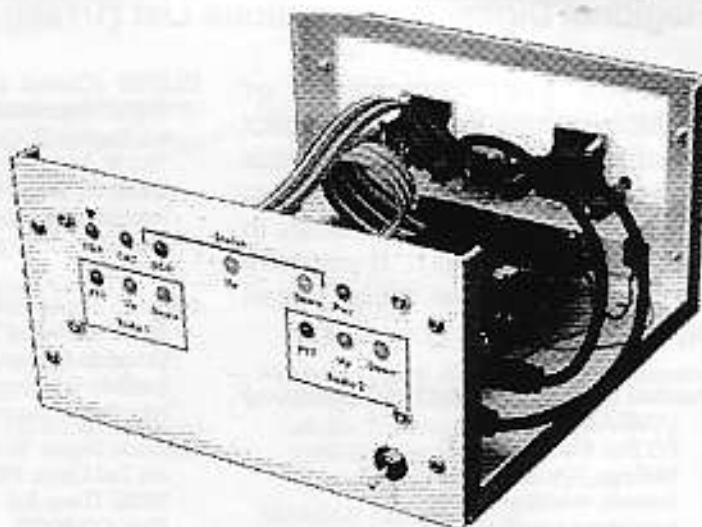


Side View of Unit (front is to right). The EVM sits in the middle of the enclosure with the radio interface to the rear and display to the front.

This design of the radio interface for the Motorola DSP56002EVM is based on Johan Forrer's, KC7WW, original design (see <http://www.tapr.org/~n7hpr/evm/evmpcb.pdf> last revised February 1996). In February 1997, Douglas Braun, N1OWU, released his software suite for the EVM and revised his interface to be more flexible than Johan's. The TAPR interface is a happy medium between Johan's



Rear View of Enclosure



Front View of Enclosure

and Doug's design. The goal is to make the interface flexible for past and present code developed for the EVM and to create a flexible programming interface for future programmers.

If there is enough interest, TAPR might try to keep a small quantity of EVM cards at the office for those who are interested.

TPRS Fall Digital Symposium

The Texas Packet Radio Society held its Fall Digital Symposium this past December in Austin, Texas. There was a lot of discussion regarding the TAPR FHSS radio project and other topics.

The following presentations were made:

Antennas, feedlines, propagation for 915 Mhz
Bob Morgan, WB5AOH

TAPR 900Mhz FHSS Radio; Channel Capacity Issues
Tom McDermott, N5EG

TAPR FHSS Radio Design Status Update
Bob Stricklin, N5BRG

Spread Spectrum Rulcmaking and TAPR Projects
Greg Jones, WD5IVD

Texnet Update and TexNet status update
Bob Morgan, WB5AOH

TCP/IP Services on modern platforms
Greg Jones, WD5IVD and Tom McDermott, N5EG

All the audio and overheads can be found on the TAPR virtual meetings page:

<http://www.tapr.org/tapr/html/virtual.html>

Regional Digital Organizations List (1/1/98)

If you have corrections or additions to this list, please contact the office. TAPR hopes to keep this list as accurate as possible in order to refer information and individuals to their regional group(s). If you have corrections to this list, please e-mail tapr@tapr.org.

Amateur Radio Research and Development Corp (AMRAD)
PO Box 6148
McLean, VA 22106-6148
Internet: w4ri@amrad.org
<http://www.amrad.org/>
Newsletter: AMRAD Newsletter

American Radio Relay League (ARRL)
225 Main St
Newington, CT 06111
Internet: INFO@ARRL.ORG
<http://www.acs.oakland.edu/barc/arrl.html>
Newsletter: QEX / Gateway

Arizona Network Intertie Group (AzNET)
c/o Daniel Meredith, N7MRP
P.O. Box 44563
Phoenix, Arizona 85064-4563
Internet: aznet@phx-az.com
<http://www.stat.com/catch22/aznetlig>

The BlueRidge Video and Digital Society (BVDS)
c/o Lee McDaniel WB4QOJ
PO Box 7873
Roanoke, Virginia 24019
Internet: wb4qoj@roava.net
<http://www.roava.net/bvds.org>

Carolina Digital Coordinating Council
c/o Chris Cullingford KB4CCU
210 Byswick Pl.
Charlotte, NC 28270
<http://ham.wb4uds.org/cdec>
Internet: cnc@vnet.net

Central Illinois Packet Radio User Society, Inc (CIPRUS)
c/o Larry Keenan K9ORP
RR 1 Box 181
Hudson, IL 61748-9750

Central Iowa Technical Society (CITS)
c/o Ralph Wallis W0RPK
1250 Hwy G24
Indianapolis, IA 50125

Chicago Amateur Packet Radio Association (CAPRA)
PO Box 8251
Rolling Meadows, IL 60008
Newsletter: The CAPRA Beacon
Internet: cherg@svs.com
<http://www.pyrotechnics.com/capra/>

Cincinnati Amateur Packet Radio Experimenters Society (CAPRES)
c/o John Schroer IV KA8GRH
948 Halesworth Dr
Forest Park, OH 45240

CLEDO (Central Lakeshore Experimenter's Digital Organization)
c/o Stephen D. Goff, N8IVX
782 W. Main St.
Bellevue, Ohio 44811
Internet: n8ivx@onebellevue.com
<http://www.onebellevue.com/n8ivx/cledo/index.html>

Colorado Digital Eclectics (CODE)
3631 Brentwood Terrace
Colorado Springs, CO 80910
Internet: info@code.org
<http://www.gag.com/code/>

Colorado Digital Working Group
c/o Ted Cross, N0LAK
33165 Diana Rd,
Pine, CO 80470
Internet: ted@rnsd.com
<http://www.rnsd.com/hamradio/dwg.html>

Colorado Packet Association (COPA)
c/o John Radomski KT0H
2080 S Fairplay
Aurora, CO 80014

Connecticut Digital Radio Association (CDRA)
c/o William Lyman, N1NWP
219 So Orchard St.
Wallingford, CT 06492
Internet: lyman@nai.net

Eastern Washington Amateur Radio Group (EWARG)
Pat Dockrey, N07M
Post Office Box 644
Spokane, WA 99210
Internet: msvc@ieway.com

First Coast Amateur Digital Association (FICADA) [North East Florida]
c/o Bill Layfield KD4UJK, President
2822 Tinsley Road
Jacksonville, Florida 32218-4677
Internet: kd4ujk@jaxnet.com

Florida Amateur Digital Communications Association (FADCA)
c/o Joseph Kuntz, WB4TEM
812 Childers Loop
Brandon, FL 33511
Newsletter: FADCA Beacon

Georgia Radio Amateur Packet Enthusiast Society (GRAPES)
P.O. Box 636
Griffin, GA 30224
<http://www.mindspring.com/~bobm/grapes/grapes.html>
Newsletter: Grapevine

Indiana Digital Experimenters Association (IDEA)
c/o John Hartman N5AAA
14659 Wellington Ct.
Noblesville IN 46060-4356
<http://www.ideanet.org>

Kansas Digital Coordinating Committee
1544 N 1000 RD
Lawrence KS 66046-9610

Mississippi Amateur Radio Digital Association (MARD)
c/o Patrick J Fagan WA5DYV
2412 E Birch Dr
Gulfport, MS 39503

Missouri Amateur Packet Radio Society (MoAPRS)
c/o Tom Hammond, N0SS
5417 Scruggs Station Rd.
Lohman, MO 65053
Internet: thammond@mail.state.mo.us

Mt Ascutney Amateur Packet Radio Association
c/o Carl Breuning N1CB
54 Myrtle St
Newport, NH 03773

Mt Beacon Amateur Radio Club
PO Box 841
Wappingers Falls, NY 12590

Nevada Packet Coordinators Committee (NPCC)
PO Box 12116
Reno NV 89510
Internet: k3tv@connectus.com
Newsletter: The NPCC Rag

New England Packet Radio Association (NEPRA)
PO Box 208
East Kingston, NH 03827
Newsletter: NEPRA PacketEar

New Mexico Packet Radio Society (NMPRS)
c/o Brian Milesosky, N5ZGT
1021 Dakota SE
Albuquerque, New Mexico 87108
Internet: n5zgt@swcp.com

North East Digital Association (NEDA)
PO Box 563
Manchester, NH 03105
Internet: neda@telecom.com
<http://www.cam.org/~ama/neda/NEDA.html>

The Northeast TCP Association (NETCPA)
c/o Steve Meuse
80 Broadmeadow Drive
East Bridgewater, MA 02333
Internet: info@netcpa.org
<http://www.netcpa.org>

Northern California Packet Association (NCPA)
P.O. Box 61716
Sunnyvale, CA 94088
<http://arasmith.com/~ncpa>
Newsletter: NCPA Downlink

North Mississippi Digital Radio Association (NMDRA)
c/o Craig Lindsey, KC5AUG
PO Box 5054
Mississippi State, MS 39762-5054
Internet: craig@verner.ssrc.msstate.edu
<http://www.ssrc.msstate.edu/~craig/NMDRA>

Ohio Packet Enthusiasts Club (OPAC)
c/o Bob Ball WB8WGA
830 Riva Ridge Blvd
Gahanna, OH 43230

- Ontario/Western NY Packet Advisory Group (OWNYPAG)
c/o Paul Savini KB2KRB
779 Englewood Avenue Apt. 1
Kenmore, NY 14223-2330
Internet: aa585@freenet.buffalo.edu
- Pacific Packet Radio Society (PPRS)
PO Box 51562
Palo Alto, CA 94303
- Packet Association of Western New York (PAWNY)
P.O. Box 1856
Cheektowaga, NY, 14225-8856
Internet: info@hamgate.sunysc.edu
http://hamgate1.sunysc.edu
- PacketEast of North Carolina
Network and Frequency Coordination for
Eastern North Carolina
c/o Gary Pearce KN4AQ, VP
116 Waterfall Ct.
Cary, NC 27513
Internet: kn4aq.gary@nmsa.net
- Packet Radio Organization of Montana (PROM)
c/o Glenda Allen KL7IB
165 Conifer Rd
Libby, MT 59923
- Pennsylvania Packet Association (PaPA)
c/o Bryan Simunic WA3UFN
9 Wild Cherry Dr
DuBois, PA 15801
- Puget Sound Amateur Radio TCP/IP Group
c/o Steve Stroh N8GNJ
14919 NE 163rd Street
Woodinville, WA 98072
Internet: strohs@halcyon.com
http://www.wetnet.ampr.org
- Radio Amateur Satellite Corp (AMSAT)
PO Box 27
Washington, DC 20044
http://www.qualcomm.com/amsat/AmsatHome.html
Newsletter: AMSAT Journal
- Radio Amateur Telecommunications Society (RATS)
c/o Brian Boccardi, N2MPM
PO Box 93
Park Ridge, NJ 07656
http://www.rats.org
- Rochester Packet Group
c/o Fred Cupp W2DUC
27 Crescent Rd
Fairport, NY 14450
- San Diego Packet Radio Association (SAND-PAC)
c/o Barry Gershenfeld
5085 Arroyo Lindo Av
San Diego, CA 92117
Newsletter: San Diego Packet Radio Association Newsletter
- South Carolina Amateur Radio Digital Society (SCARDS)
PO Box 1281
Columbia, SC 29202
Newsletter: SCARDS Newsletter
- Southern Amateur Packet Society (SAPS)
c/o Wayne Harrell WD4LYV
Rt 1 Box 368
Sycamore, GA 31790
http://www.south.com/~cpac/saps.htm
- Southern California Association of Packet-Radio System Operators (SCAPS)
P.O. Box 65643
Los Angeles, Ca. 90065
Internet: k6ve@aol.com
- Southern California Digital Communications Council (SCDCC)
PO Box 2744
Huntington Beach, CA 92647-2744
Newsletter: The I-Frame
- Southern Oregon Amateur Packet Radio Association (SOAPRA)
c/o Albert D. Lawson
232 Talent Ave. #36
Talent, OR 97540
Internet: wb7awl@soapra.org
http://soapra.org
- Southern Utah Packet Users Group (SUPUG)
c/o Ken Oliver N6KBM
2126 Cobblecreek Dr.
Cedar City, UT 84720
Internet: knoliver@tcd.net
- Tennessee Backbone Operators Network Environment (TBONE)
c/o Terry Cox, KB4KA
110 Fisherville Rd.
Collierville, TN 38017-4100
Internet: tcox@fedex.com
- Tennessee Network (TENNET)
c/o Jeffrey Austen K9JA
2051 Clearview Drive
Cookeville, TN 38506
Internet: jra1854@ntech.edu
- Texas Packet Radio Society (TPRS)
PO Box 50238
Denton, TX 76206-0238
Internet: wo5h@tpr.org
http://www.tpr.org/tprs
Newsletter: The TPRS Quarterly Report
- Treasure Coast Packet Group (TCPG)
c/o Bill Britton KB4VOL
8709 SE Jardine St.
Hobe Sound FL 33455
Internet: w2kgv@juno.com
- Tucson Amateur Packet Radio Corporation (TAPR)
8987-309 E. Tinque Verde Rd #337
Tucson, AZ 85749-9399
Internet: TAPR@TAPR.ORG
http://www.tapr.org
Newsletter: Packet Status Register
- TwinsLAN Amateur Radio Club
PO Box 32301
Fridley, MN 55432
Newsletter: The TwinsLAN Beacon
- Utah Packet Radio Association (UPRA)
c/o Bart Van Allen KA7ZFD
11883 S Kinney Cir
Riverton, UT 84065
- Wake Digital Communications Group (WDCG)
c/o Randy Ray WA5SZL
9401 Taurus Ct
Raleigh, NC 27612
- Western Michigan Packet Radio Association (WMPRA)
PO Box 4612
Muskegon, MI 49444
- Wisconsin Amateur Packet Radio Association (WAPRA)
PO Box 1215
Fond Du Lac, WI 54935
Newsletter: Badger State Smoke Signals
- Canada
HEX 9 Group
PO Box 151
Orillia, ON L3V 6J3 Canada
- Manitoba Digital Emergency Communications Groups (MDECG)
c/o Jim Townsend, VE4CY
2109-55 Garry St.
Winnipeg, MB R3C 4H4 Canada
- MARCAN Packet Network
c/o Ron MacKay VE1AIC
Box 188
Cornwall, PE C0A 1H0 Canada
Packet:
VE1AIC@VE1AIC.PE.CAN.NOAM
Internet: rmackay@peinet.pe.ca
- Ontario/Western NY Packet Advisory Group (OWNYPAG)
c/o Paul Savini KB2KRB
779 Englewood Avenue Apt. 1
Kenmore, NY 14223-2330
Internet: aa585@freenet.buffalo.edu
- Ottawa Amateur Radio Club Packet Working Group
Lincoln Heights Postal Outlet
P.O. Box 32032
1386 Richmond Road
Ottawa, ON K2B 8B0
Internet: bni@hydra.carleton.ca
- Vancouver Amateur Digital Communications Group (VADCG)
9531 Odlin Rd
Richmond, BC V6X 1E1 Canada
Newsletter: The Packet
- Vancouver Area Packet Organization (VAPO)
c/o Rob Reid, VE7FU
6510 Bradford Place,
Delta, B.C. V4E1G3 Canada
Internet: rsreid@axionet.com
http://mindlink.net/rob_reid/vapo.html
Newsletter: VAPO Gazette
- Winnipeg Amateur Radio Packet group (WARP)
c/o Chris Setla, VE4SET
158 Fairlane Ave
Winnipeg, MB R2Y 0B3 Canada

1998 Dayton Hamvention Digital Communication Events!

Last year the TAPR Digital Forum was held in the large curtained areas, but we have found out that this area is now an exhibitor area. We should know the location of the forum by the next PSR. We are currently working on the speakers for the forum. If you have any suggestions, please let us know. Also, it has been rumored that the Hamvention on Friday will open much earlier than in years past.

The 1998 "Packet BASH" sponsored by TAPR and the Miami Valley FM Association will be held on Friday of the Dayton Hamvention. The BASH will again be held at the NCR location south of Dayton. It is a great spot and we look forward to having a third year there.

A buffet dinner, a raffle for some neat prizes, a great program, and lots of fun are in store. Keep an eye on TAPR-BB and the Web pages for the latest information.

This will be an opportunity for packet and digital radio enthusiasts to have a great night out while at Hamvention.

The schedule of events is still tentative, but will look something like this:

- 1900 Dinner
- 1945 Welcome
- 2000 Keynote Address
- 2030 Raffle
- 2045 TAPR SIG Meetings

For more information, send email to "packbash@n8ur.ampr.org" or stop by the TAPR booth at Dayton for schedule and map.

1998 ARRL and TAPR Digital Communications Conference

Chicago will be the site of the 1998 ARRL and TAPR DCC. Contracts are underway with the hotel and the conference should be held on the weekend of September 25-27 or as an alternative date the 20-21st. CAPRA will be the local host and we will be working with PRUG (Packet Radio Users Group of Japan) to be the first ever international host, which we hope will become a regular part of the conference. More information will be released in the coming weeks as the location, hotel, schedule, workshops, and registration prices are fixed by the conference committee. Check <http://www.tapr.org/dcc>.

There will again be a National APRS Symposium held on Friday and Steve Dimse, K4HG, will coordinate the event. If you have suggestions for the Sunday seminar, please let the office know. Student papers will again be accepted and the deadline will be in June. We hope that this year's DCC will continue the positive trend witnessed over the last three years.

How to make APRSDos Maps from the USGS CDs

Arte Booten
n2zrc@webspan.net

The first thing you need to do to make APRSDos Maps from the U.S.G.S. CD is to GET THE CD! They can be obtained from:

USGS Earth Science Info Center
507 National Center
Reston, Virginia 22092

or dial 1-800-627-0039 to place a credit card order to MapExpress.

Be sure to ask for the "1:100,000-Scale Digital Line Graph Data Hydrography and Transportation, Optional Format" CD. The thirteen discs cover the following areas:

- Area 1 = ME, NH, VT, MA, RI, CT and NY
- Area 2 = NJ, PA, OH, DE, MD, DC, VA and WV
- Area 3 = NC, SC and GA
- Area 4 = FL
- Area 5 = TN, AL, MS, LA and AR
- Area 6 = IN, TN, IL, MO and IA
- Area 7 = MI, WI and MN
- Area 8 = TX and OK
- Area 9 = NE, KS and CO
- Area 10 = ND, SD, MT and WY
- Area 11 = NM and AZ
- Area 12 = NV and CA
- Area 13 = ID, OR and WA
- Area 51 = Undisclosed location someplace in NV!

Once you have the CD, there are two ways to proceed. If you want to install the CD on your harddrive, do so, but it's not necessary. It is just a bit faster (but not much.)

After the CD has been installed, type `cd\dlg` (or whatever directory you put it in) (if you didn't install it, start here!) and then start it up with `DLG.BAT`. Then tell it you want to extract DLG files. A graphic appears on your screen showing the area the CD covers. Select *View Quad* to zoom into the area of interest, left-click on it, then right-click.

Now go to *Map Features* and select *ROADS* and *HYDRO*. You might also put in *Railroads* if your area is sparse on roads and small lakes. Then press enter and tell it where you want the expanded files to go.

The Other Method

Put the CD in the CD reader and invoke `DLG.BAT`. Move the cursor around and take note of the name of the quad which appears in the blue box. Close that program.

Look in the directory of the CD, and under 100k_dlg you will find a subdirectory which corresponds to the first eight letters of the name of the quad. This contains four zip files. You want to unzip the ones that have HYDRO, ROADS and, if desired, RAIL. Unzip them all into the same directory.

Now go to the TAPR site and download Mk100k3.zip, which is the program you're going to use to actually make the maps from the CD data you just unzipped. Unzip MK100k3.exe to the same directory we've been using, and put the text file in your APRS\README directory, then start it.

Okay. Here comes the hard part. You have to determine either the center of a single map's lat/lon, or the northwest corner of a series of maps that you'd like to make. You also need to decide what scale they should be. If the area is sparse in roads, you may be able to get by with four-milers, but some areas can only be done at a half-mile scale. You'll find out soon enough if it's too big!

Let's start by making a single four-mile map. Change directories to the one we're using and type MK100k3.exe. Following the prompts, type in the path to where you are, press enter, press enter again to tell it you're using the CD, then type in the name you want the map to have. Now enter in the latitude in DD,MM,MM (note the comma and dot!) followed by the longitude in the same format. Then tell it you want a 4-mile map. Press enter again to confirm the detail level and press 1 for one map. Now sit back and wait. It's kind of fun (for a bit) to watch the maps form from the data.

Once Mk100k3's done, it'll tell you whether or not the all-important POINT COUNT is within the 3000-point limit. If it's below 3000, it'll be automatically saved as a ".map" file. If not, it'll get saved as a ".dat" file, which may or may not be fixable. More on that later.

If the product of Mk100k3 exceeds the 3000-point limit look in your main APRS directory. See an executable called Mapfix##.exe? Fire it up. Do a bit of reading and a <cr>. Read a little more and load up the new MAP or DAT file. Look at the upper right corner and see what the actual POINT COUNT is. How far above the limit is it? 3500? 4000? More? If it's much above, say, 41-4200 area, it may have a chance. If it's much bigger you may as well toss it now.

It's now time to start winnowing it down. The first thing you can do is to press T(asks) S(krunch), which eliminates small turns in the road. You can use the default slope of 1.2, or maybe a bit more depending on the density of the map. When it's done it'll beep at

you. Then press the spacebar to see if you've gotten below the 3000-point point.

If not, and you've got lots of little ponds or lakes, you can delete them by clicking on them and pressing E(dit) K(ill feature). It's surprising how many little puddles are on those CD's, just eating up map points!

Still have too many? This is where it gets interesting (and boring, and repetitive, and the point where some folks throw their hands up and cry bloody murder!) Put your finger on the P(revious feature) key and keep it there until you get to the first map point. Press E(dit) L(ock) and start going through the map point by point, deleting those that are superfluous. Sometimes this means a slightly less crinkly coastline. Sometimes you can eliminate points on a line that are intermediate to other points.

And sometimes you have to be ruthless! I remember one 4277-point beast that I finally (barely) got down to exactly 3000 by eliminating a whole lot of bends in the streets. This is one of those cases where the interest isn't how graceful the bear dances, but merely that that bear CAN dance.

If, through all these methods, you STILL can't get the map down to a manageable level, toss it. Make smaller ones.

There are three ways of saving maps for APRSDos: Normal, Line-format, and Compressed. The advantages of the latter two is that they both save drive space and load a bit faster. But in order to save them in that format, all of the map's points MUST BE WITHIN THE YELLOW BOX!

This is actually fairly easy, though tedious, to do. I start in the northeast corner of the map, zoom in to a tight scale and either delete or move points to a point JUST inside the box.

Once you have the saved map, you want to get it into a maplist. In your main APRS folder you'll find a QBASIC program called MKMAPLIST.BAS.

Run it. You'll wind up with a file which gives the map's name(s), center, scale and at what point of magnification it should appear. Tack this stuff onto the bottom of MAPLIST.USA, rename the maplist with an appropriate extension and edit the comments, if you like.

Congratulations! You have just created some new APRS maps! You might want to consider uploading them to the APRS UPLOAD area of TAPR's FTP site so we all could enjoy them. Some of us are actually map collectors. I just happen to have about 3300 DOS maps (this week.)

Kits/Publications Update

TAPR Member's Mug, Shirts, and Badges

Don't forget that TAPR has mugs, shirts, and callsign badges available. The TAPR mug is an 11oz white Porcelain Mug which has TAPR logos in both Black and Microwavable Gold. TAPR shirts are available in a variety of sizes, styles, and colors with the TAPR logo stitched into the material. You can also have your name and callsign added underneath. And as always TAPR badges are still popular. Let everyone know you're a member and supporter of TAPR!

TAPR GPS Update

The TAPR GPS Page has been updated to include the Garmin GPS-25 OEM board, Garmin GA-27, and several new Motorola GPS units. See <http://www.tapr.org/gps/> Steve Bible, N7HPR, has taken over the task of keeping up with various GPS technologies that can be made available to the membership through TAPR.

The GPS-25 is \$20 more expensive than the GPS-20, but it is a true 12 channel parallel sensor. Several of you have contacted the office about when we would have these — they are available now for ordering. As with the GPS-20, we will be placing orders the first of each month. We will continue to offer the GPS-20 as long as Garmin makes them available for those that want the multitrack unit.

TAPR will begin to offer both the Garmin GA27 and Motorola Antenna97. This should provide good choices to the membership for antennas, something that has been lacking.

Also, keep an eye out for an inexpensive solution for DGPS. Something that a lot of you have

been asking for over the last year. When a kit or possible semi-kit is available, it should be very popular! TAPR will post something when official.

On a last note regarding the GPS30PC offer — out of the some 500+ units made available to members, we had 5 failed units returned. Special thanks to Brad Wiseman and GARMIN for allowing TAPR to make these units available to the amateur radio community. Dorothy reported that we had about 15 GPS30PCs left that have either been orders that were canceled or not purchased after sending e-mail.

TUC-52 and METCON-II personality board

The TUC-52 is very close to going to beta test. Just waiting for two parts to arrive so that we can send out the kits to the testers. The METCON-II personality board is in from the board shop and Paul Newland, AD7L, is building it up to see what we have. With luck we can proceed with the beta testing of the METCON-II shortly.

There should be more news in upcoming PSRs concerning the enclosure development for the TUC-52.

DAS - Digital Accessory Squelch

DAS kits are still available. We will be looking at another run of boards so that we have another 100 kits to sell.

TAC-2

The TAC-2 has been shipping at a steady rate since it became available. The TOC development team is working on the clock option, but until some of the commitments are completed by the development group, the project will be on a slow track. For more details on the TAC-2, just subscribe to the TACGPS mailing list. There is an excellent discussion on XNTP and other issues on the TACGPS list.

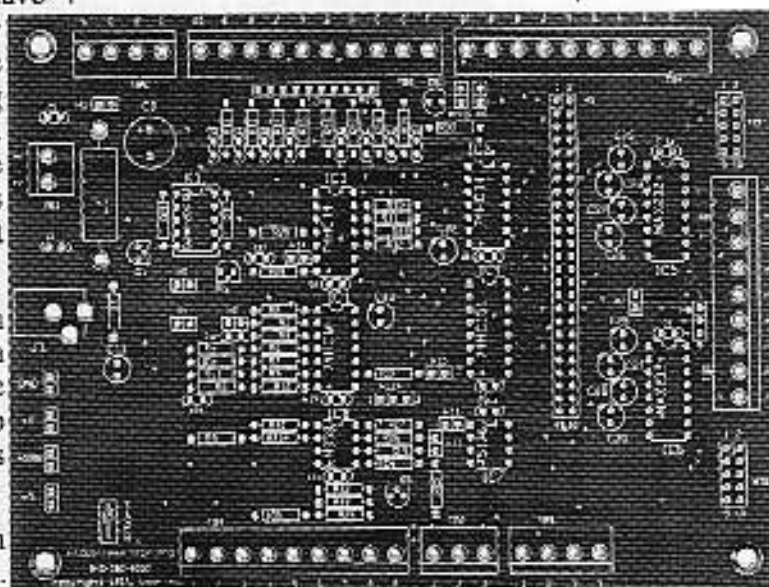
MIC-E

Another 50 kits are being completed and should be available through the office the first of February. If you have questions about what the MIC-E does or how people are using it, you can use the MIC-E mailing list.

Networking Without Wires: Amateur Radio TCP/IP

Thanks to everyone who followed up on last issue's request for an editor, we located someone and have

several new reviewers available as well. John is working on his last chapter and the necessary figures and tables are being completed. As soon as all these new elements can be merged into a new layout it will be off to the reviewers for comments. We had hoped for a Dayton printing, but with the task ahead, September is probably a better estimate at this time.



METCON-II PCB

1998 CD-ROM

The TAPR 1998 CD-ROM will be available at Dayton. The CD has been updated and some of the old stuff deleted and new stuff added. If you don't have a computer which supports the necessary browsers software, don't worry, you can still get all the data directly from the CD like before. The CD will again be a ISO-9660 standard, which will allow it be accessed on any number of platforms. The price will not change from last year -- \$20, + \$4 s/h. Keep an eye on TAPR-BB and the web page for information before the next PSR.

an eye on TAPR-BB and the web page for the latest information.

9600 Baud Land Mobile Modifications Web Page

The 9600 baud web page is now available on the TAPR web site. <http://www.tapr.org/tapr/html/pub.9600.html>. As was noted in the last issue, not all sections of the book are available as of yet, because the authors want to make some final edits and changes on certain sections. As sections are made available, they will be added to the web page. Sorry for the delay in getting this done, but it is happening. If you have modifications

you would like to add to the page, you can send them in electronic format to tapr@tapr.org or contact Greg Jones, WD5IVD.

Spread Spectrum Update

The Spread Spectrum Update publication is back off of hold and is moving forward. Papers and articles to be included are being gathered currently. The goal of this publication will be to have a new updated booklet of information available on the topic of Spread Spectrum. Keep an eye for more information in the next PSR.

ARRL Bulletin 58: FCC announces Electronic Renewal Form 900

Hams now can renew their licenses on line. The FCC's Wireless Telecommunications Bureau (WTB) has consolidated eight renewal forms into one form. Form 900, Application for Electronic Renewal of Wireless Radio Services Authorizations, is an interim measure to permit all WTB licensees, including hams, to renew their licenses electronically.

This form is only for renewals, not for license modifications. You can only enter changes (eg, name, address) using Form 900 as a part of the process of renewing your license. You can only use Form 900 if the expiration date on your license falls within the renewal window (within 120 days of expiration). You cannot use Form 900 to renew an expired license. Form 900 may only be submitted electronically. No Form 900 paper applications will be accepted. When filing Form 900, you will be required to enter a Social Security Number for a taxpayer ID number.

Access Form 900 on the WTB Electronic Commerce page: <http://www.fcc.gov/wtb/electcom.html> (click on Production Page for Electronic Commerce Applications to access the Form 900). Click on any item number for filing instructions. Once you have filed the form, clicking on Electronic Renewal Query lets you view or print the information submitted.

Once you have successfully submitted Form 900, it is important to click on the Continue button to obtain the fee information pertaining to your filing. The screen will prompt you with a Fee Remittance Advice, Form 159. The form will indicate that there is no charge to renew an Amateur Radio license (except for vanity call sign holders, who won't have to renew for several more years yet). Form 900 updates will be batch processed at night. They are not instantaneous.

Send comments about the FCC Form 900 to srccd@fcc.gov. For technical assistance, call the FCC Technical Support Group at 202-414-1250. Other general information may be obtained from the FCC's National Call Center at 888-225-5322 (CALL-FCC).

Mail-in Ballot for TAPR Board of Directors Election

All Information Must be Provided:	Vote for up to three:
Name (printed):	<input type="checkbox"/> John Ackermann, N8UR (ex-AG9V)
Member Number:	<input type="checkbox"/> Barry McLarnon, VE3JF
Check Number (from mailing label):	<input type="checkbox"/> Jim Neely, WA5LHS
Signature:	<input type="checkbox"/> Doug McKinney, KC3RL

Mail to: TAPR, 8987-309 E. Tanque Verde Rd. #337, Tucson, AZ 85749-9399. Must be received by March 15, 1997.

Kits	Price	Qty	Total	Kit Code	Information
TAPR APRIS™ MIC-Encoder™	\$149.00			20	
TAC-2 (Totally Accurate Clock)	\$139.00			10	
DAS (DIME Accessory Squelch)	\$68.00			3	As seen in Dec '95 QST
DSP-93 w/ wall transformer	\$430.00			16	check with office on ship date, no discount
AN-93 HF Modem	\$90.00			3	limited kits available
TAPR 9600 bps Modem	\$40.00			6	
Bit Regenerator	\$10.00			1	used for regenerative repeater operation
Clock Option	\$5.00			1	used for regenerative repeater operation
PK-232 Modem Disconnect	\$20.00			2	simplifies connection of external modems
PK-232MBX Miscellaneous Kit	\$20.00			2	for installation of 9600 modem in PK-232-BX
XR2211 DCD Mod.	\$20.00			2	
State Machine DCD Mod.	\$20.00			2	
State Machine DCD w/line Clock	\$25.00			2	For RTD or other TNC w/ 16K or 32K tx clock
Flimware					
32K RAM w/ TNC2 update docs	\$20.00			2	
TNC-2 1.1.9 w/KISS EPROM	\$15.00			4	includes 1.1.9 Commands booklet (below)
1.1.9 Commands Booklet (only)	\$8.00			2	full TNC-2 command set for 1.1.9
TNC-2 WABDED EPROM	\$12.00			2	B correct version for ARS/DMA standard
TNC-1 WABDED EPROM	\$12.00			2	
TNC-2 KISS EPROM	\$12.00			2	
TNC-1 KISS EPROM	\$12.00			2	
PK-87 WABDED EPROM	\$12.00			2	
Publications					
1997 TAPR CD-ROM	\$20.00			4	ISO 9660, 650 Mbytes of info w/ hard copy pages
Wireless Digital Communications	\$39.99			8	300+ pages w/ disk by: Tom McDermott, N5EG
Packet Radio: What's Why? How?	\$12.00			2	130 pages: TAPR's Packet Radio book.
BBS Sysop Guide	\$9.00			2	60 pages, by: Barry Burlew, W4DRJ
TAPR's 94 Annual Proceedings	\$7.00			2	Papers from the Annual Meeting (Tucson)
TAPR's 95 Annual Proceedings	\$7.00			2	Papers from the Annual Meeting (St. Louis)
PSR Set Vol 1 (#1 - #17 '82 - '85)	\$20.00			8	
PSR Set Vol 2 (#18 - #36 '86 - '89)	\$20.00			8	
PSR Set Vol 3 (#37 - #52 '90 - '93)	\$20.00			8	
ARRL/TAPR 1997 DCC	15.00			2	
ARRL CNC Proceedings 1st - 16th	call			1	1997 DCC Proceedings Baltimore, MD
Entire Set ARRL DCC 1st - 16th	\$120.00			144	Individual Proceedings, call for prices
Other:					12 Proceedings from 1981 to 1997
TAPR 11oz Coffee Mug logo	\$11.00			4	Logo in black and microwaveable gold
TAPR Badge	\$10.00			0	include Name and Call for badge
TAPR Shirt - 4 styles				0	http://www.tapr.org/tapr/shirts.html
3 1/2" Disk from TAPR Library	\$3.00			0	\$3 per disk. See TAPR Software Library List
GPS					
Garmin GPS-20 (Member Price)	\$169.00			28	No Discount.
Oncore VP GPS (Member Price)	\$269.00			28	No Discount.
Garmin GPS-20 Data Cable	\$15.00			2	No Discount.
MCX Re-Ang Connector w/coax pigtail	\$15.00			2	No Discount.
Garmin GPS-20 Interface/Power Kit	\$35.00			8	No Discount.
Oncore VP Interface/Power Kit	\$35.00			8	

Subtotal:

Added Total Kit Codes

All prices subject to change without notice and are payable in U.S. funds. Members receive 10% off on Kits and Publications. Please allow six to eight weeks for your order to be shipped. For specific information on kits, see Product Description flyer.



Tucson Amateur Packet Radio
 8987-309 E. Tanque Verde Rd #337
 Tucson, Arizona • 85749-9399
 Office: (940) 383-0000 • Fax: (940) 566-2544
 Internet: TAPR@TAPR.ORG • www.tapr.org
 Non-Profit Research and Development Corporation

December 1997

www.tapr.org • ftp.tapr.org • tapr@tapr.org
 Office Hours: Tue-Fri 9am-12pm, 3pm-5pm CT

Membership		Price	Number of Years	Total
United States		\$20.00		
Canada/Mexico		\$20.00		
International		\$25.00		

☐ Renewal ☐ New Member

SubTotal

Membership 10% Discount

Member #: _____ (Place new if joining)

Total Sales (Subtotal minus discount)

Texas Residents (7.75% tax)

Membership (New or Renewal)

Shipping and Handling

For Total Kit Codes Between

1-3	4-7	8-15	16-27	28-55
Add \$1	Add \$4	Add \$5	Add \$6	Add \$7

Kit Codes above 55 or International orders must contact TAPR for amount.

TOTAL Order Amount

☐ Charge my credit card (check one):

☐ VISA ☐ MasterCard

Acct # _____

Expiration Date: _____

Signature on card: _____



Name / Call: _____

Street Address: _____

City / State / Zip: _____

Country: _____ Phone Number: _____

Internet E-mail: _____