TAPR

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Tucson Amateur Packet Radio
PO Box 12925
Tucson, AZ 85732
Phone: 602-323-1710

Editor:
Bob Nielsen, W6SWE
1400 E. Camino de la Sombra
Tucson, AZ 85718-3915
CompuServe: 71540,2364

Associate Editor:
Bob Hansen, N2GDE
PO Box 1902
Elmira, NY 14902-1902
CompuServe: 71121,1007

In This Issue...

PRESIDENT'S CORNER

by Andy Freeborn, N0CCZ

Cast Your Vote

Included with this issue of PSR you will find a ballot to be used to cast your vote for five TAPR directors. The TAPR Board of Directors consists of 15 members, each serving three year terms. Each year, one-third of the Board terms expire and are opened for nominations. In addition you will find biographical comments concerning each of those that have been nominated to fill those positions.

Voting will be by mail only and ballots must be received at the TAPR office no later than Tuesday, February 20th. It is necessary to have a ballot count by the 20th in order that those elected can arrange to be in Tucson for the Board of Directors meeting on Friday, February 23rd.

Historically, the ranks of the TAPR Board of Directors have been filled by the movers and shakers from within the amateur community. TAPR has been very fortunate to have had some of amateur radio's finest technical talent and leadership on its Board over the past years. It is important to the management of TAPR that the board have access to folks like these. It is through their wealth of experience and technical backgrounds that your Board can properly evaluate present and future TAPR programs.

Annual Meeting February 24th - 25th

Networking, that's the packet radio buzzword for the early '90s. And that will be one of the main topics at the 1990 TAPR annual meeting. Equally exciting will be discussions by members of the Microsat team describing and graphically displaying the construction, pre/launch and launch activity of the Microsats and their UoSAT cousins. Six of them launched in one gaggle, wow!

As in recent years the meeting will be held at the Inn At The Airport, 7060 South Tucson Boulevard, Tucson AZ, 85706. The Inn is a very short distance from the airport terminal, walking distance if you're so inclined. Special rates for the meeting are $49.00 for either one or two in a room. Breakfast is included as well as a late afternoon cocktail hour. Our room block will be released on February 9, 1990 so get your reservations in prior to that date. Call 1-800-772-3847 if outside Arizona, 602-746-0271 if in Arizona, or write the above address. Cite The TAPR Conference to assure rates.

There will be a registration fee of $20.00. This fee will help to defray meeting costs, lunch and private dinner at the hotel. Since breakfast and cocktail hour are provided to those staying at the hotel the overall cost is quite nominal. The Sunday session should be completed by noon or shortly thereafter for those planning return travel on Sunday afternoon.✦

UPGRADE KIT INFORMATION ERRORS (and news)!

by Lyle Johnson, WA7GXD

Note To XR2211 DCD Upgrade Owners!

If you installed the TAPR XR2211 DCD UPGRADE kit in your TNC, you should remove the 470K or 510K resistor that connects to pin 3 of the XR2211 chip on the TNC's main PC board. This was overlooked in instructions dated prior to November 1989. Failure to clip this resistor will result in decreased sensitivity of the DCD circuitry in general. Please clip it today!

State Machine Users

The current version of the State Machine Upgrade includes an optional clock oscillator for users of TNC's which lack internal clock generators. The main class of these TNC's are the Kantronics KPC 1 and KPC 2 series.

PK232 Modem Disconnect

The DCD jumper (JMP) on the modem disconnect is miswired. If you are not using a DCD State Machine with your PK-232, DO NOT CONNECT THE JUMPER! Instead, solder a jumper wire across pins 5 and 7 of the 8-pin connector where the State Machine would otherwise attach. This error in PC layout is being corrected in Rev. 2 of the PC board. The PakMail daughterboard interferes with the modem disconnect board physically. The November 1989 instruction sheet explains how to build your unit so this won't be a problem. A Rev. 2 board is now being produced which allows for the PakMail daughterboard with no interference problems.

There is another error in the PC board on this product. Please cut the small trace on the top of the PC board coming from pin 8 of the State Machine connector (the far right-hand pin). This trace passes near P7 pin 40. Next, add a small wire jumper on the bottom of the PC board from pin 8 of the State Machine connector to pin 17 of P1 (the modem disconnect header). This will allow the optional DCD State Machine to function properly with the PK-232. ✦

Minutes of the Tucson Amateur Packet Radio Corporation Board of Directors Meeting 1989 February 24

The meeting was called to order in Tucson, Arizona, on February 24, 1989 by President Freeborn.

Directors in attendance: Price, Morrison, Antonio, Clark, Eaton, Karn, Gregory, Brock, Garbee, Toth, Gustafson, and Goode. Director Johnson was away on a business trip, but met with the executive committee on the preceding day.

A) Summary of the year's activities:
- PS-186: there is a question of TAPR acquiring the amateur rights.
- Dayton 88: Toth, Eaton et al. were in the AMSAT booth.
- Membership: now near 640 from about 480.
- By-laws were revised.
- The completion of the TAPR-AMSAT DSP memorandum of understanding.
- Contribution to AMSAT for a Microsat - for digital circuitry, batteries, and solar panels.
- Improved nature of PSR; more technical articles are needed.
- TNC-2 royalties are drawing to a close.

B) The minutes of the previous meeting were introduced. Moved by Clark, seconded by Gregory that they be adopted. Passed.

C) Financial report presented by Mr. Freeborn.

D) The "No-code Proposal" - Freeborn/Karn/Price. Mr. Freeborn reports that the archive of the HamNet S7 forum on this subject was sent to every ARRL director and committee, and section managers. Mr. Price will chair a meeting this weekend to develop our proposal clearly.

E) MOU with AMSAT - we are awaiting the return of the MOU from AMSAT; it is reportedly signed.

E) DSP project - Mr. Clark reports that the delay is caused by a "people resource" problem. There is a large overlap between the Microsat and DSP team.

F) The ARRL 8th Computer Networking Conference: to be held October 7, 1989 in Colorado Springs, CO, at the Air Force Academy. TAPR will be a co-host.

G) Dayton Hamfest '89 - we have acquired two booth spaces. We will also contribute to the hospitality suite at the ARRL National Convention in Dallas, June 2-4, 1989.

H) Election of Officers:

President	Andy Freeborn N0CCZ
Executive VP	Peter Eaton WB9FLW
Secretary	David Toth VE3GYQ
Treasurer	Bdale Garbee N3EUA

I) New projects: A discussion regarding support for new projects, and a review of the guidelines for obtaining such support, was undertaken. Examples include the N6GN/N3EUA microwave packet experiment, as well as at least two projects to build 1.2 Ghz amplifier decks. The K3MC TOTALLY AWESOME I/O board was described; TAPR was asked if we could support this project in some way, perhaps in kitting, etc. Discussions will continue.

J) The PacketRADIO Project. Mr. Eaton showed a mockup of the prototype. Design discussions were continuing. We will be going to the membership for beta-testing.

K) NET/ROM vs TheNET controversy: Ron Raikes requested time to appear before the board. He presented his assertions that TheNET was a more-or-less direct copy of his NET/ROM software. While the board felt that it was not our place to adjudicate this matter, we did agree to send NORD<LINK a letter advising them of the questions raised by Mr. Raikes, and our desire to provide their response to the North American amateur community.

Respectfully submitted, David B. Toth, M.D. VE3GYQ, Secretary

NON-TECH TOPICS

by Andy Freeborn, N0CCZ

TAPR Has New PSR Editors

Bob Nielsen, W6SWE, and Bob Hansen, N2GDE, are the new co-editors of our newsletter. Bob, W6SWE, lives in Tucson which makes it convenient for him to use some of the TAPR office facilities in getting the issues into the mail to you. Bob, N2GDE, lives in Elmira, NY. He will be doing the layout of *PSR*. Thanks to modern day electronic telecommunications this geographic separation should impose very little time delay in getting the *PSR*'s out. As in the past, they will continue to welcome articles from the membership that deal with packet radio technical or operational innovations.

Thanks To Scott And Linda Loftesness

Scott Loftesness, W3VS, has been our dependable editor of *Packet Status Register* since July 1987. Scott's XYL Linda has been the "woman behind the man" in getting the printing done and the issues into the mail, a thankless behind the scenes task. From the Officers, Directors, and the membership at large we extend a sincere thanks to both of you.

Also, Thanks To Greg Jones, WD5IVD

You may not have noticed that the last issue that you received was produced by interim editor Greg Jones. Typical of many TAPR volunteers, Greg is involved in many other amateur radio volunteer roles as well. Thanks, Greg, for stepping forward to pinch hit for TAPR once again.

Activity At The TAPR Office

Packeteers are showing a great interest in cleaning up the packet radio airwaves, if the rate at which they are acquiring the TAPR DCD Modification kits is any indicator. This must be gratifying to Eric Gustafson, N7CL, who researched the packet DCD problem. His papers on the subject have been published in many journals. Lyle Johnson, WA7GXD, did the kit engineering.

Lyle's TNC1 Upgrade kit is proving to be very popular with owners of the TNC1 (and the Heathkit equivalent). Sales of the PK-232 Modem Disconnect kit, another WA7GXD innovation, started in October. Considering the number of these units in use throughout packetdom we expect that handling the requests for these will keep Heather very busy at the office.

The PSK Modem has been in great demand. We believe however, that many folks are waiting for the Microsats to be in orbit before ordering theirs. Unfortunately this may create a huge rush of orders when that happens. TAPR is not in a position to invest in a large stockpile of kits, hence there may be delays in making delivery after launch. You might want to consider ordering yours now. See the order form elsewhere in this issue.

The Microsat Project

During November, TAPR received a beautiful 8" x 10" plaque from AMSAT for TAPR's contribution to the Microsat program. The top 1/3 has an AMSAT logo and the bottom 2/3 reads:

Presented to
TUCSON AMATEUR PACKET RADIO
In recognition of their
OUTSTANDING CONTRIBUTION TO

THE MICROSAT PROJECT
November 4, 1989

On behalf of the TAPR membership I want to express our gratitude to AMSAT and the Microsat development team for pursuing this most difficult project. Its successful conclusion will open many vistas for the further development of amateur packet radio.

The TAPR Software Library

Our packet radio software library is slowly growing. It now contains 24 titles, 4 of them are two diskette programs. If you know of packet radio related software that you think should be included please let me know. It must be shareware or freeware and beyond the development/testing stage. At the present we want to limit the library to packet radio related software only. I'll need a dependable source to get updates from before we include it. Sources can be CompuServe, direct from the author, a beta tester, or anyone that has immediate access to new versions as they are released. Contact me at N0CCZ @ KA0WIE, CompuServe 73177,1317 or 719-598-8373.

If you are interested in becoming the TAPR software library manager, we would welcome such a volunteer.

Return To "Instant Heroes"

In the February 1989 issue of *PSR*, I wrote an article concerning the potential of a packet radio device that would transmit/receive FAX, not just ASCII, but anything that can be sent via a standard FAX machine. The article was based on a suggestion by Phil Karn, KA9Q, and was titled "Instant Heroes".

We have received an inquiry from a non-profit, international organization providing communication systems for health-related programs in developing countries. Their inquiry was specifically directed to the type of capability described in the "Instant Heroes" article.

If any of the *PSR* readers have done any work in the area described in the article please contact me.

Make Sure You Use The Right TAPR Address

TAPR had a change in Post Offices in the fall of 1988. The period of time for the Post Office to forward mail to our new Box # and Post Office has expired. This means that folks that use the old number will have their mail returned to them as undeliverable. We have had folks call the office very disappointed that their order did not get filled as soon as they wanted due to the delay in returning their undelivered letter.

For prompt attention to your orders and correspondence please use the following address:

TAPR
P.O. Box 12925
Tucson, AZ
85732

The telephone number is (602) 323-1710

Although there have been several announcements in *PSR*, *Gateway*, CompuServe and the packet network concerning the change, there are still some that are using the old address. If you know of someone who plans to place an order with TAPR, especially non-members, please let them know the correct address.✦

TAPR Board Of Directors Election

Tucson Amateur Packet Radio is a non-profit corporation licensed in the State of Arizona as a scientific and educational institution, and likewise recognized by the IRS as a 501(c)3 tax-exempt organization for these same purposes.

TAPR is run by a Board of Directors. There are fifteen members of the Board, each of whom serves a three-year term, with five positions filled each year. Board members are expected to attend, at their own expense, the annual Board Meeting held in conjunction with the annual membership meeting in Tucson. They participate in the decision-making process and provide guidance to the officers. Continuing board discussions are held in a private section on CompuServe.

The officers and the Executive Committee of TAPR are elected by the members of the Board at the annual Board of Directors meeting.

The current members of the Board and the expiration dates of their terms are:

Franklin Antonio, N6NKF	1992
Mike Brock, WB6HHV	1991
Tom Clark, W3IWI	1990*
Pete Eaton, WB9FLW	1990*
Andy Freeborn, N0CCZ	1991
Bdale Garbee, N3EUA	1992
Steve Goode, K9NG	1992
Bob Gregory, KB6QH	1990*
Eric Gustavson, N7CL	1992
Skip Hansen, WB6YMH	1991
Lyle Johnson, WA7GXD	1992
Phil Karn, KA9Q	1991
Dan Morrison, KV7B	1991
Harold Price, NK6K	1990*
Dave Toth, VE3GYQ	1990*

This year's election is to fill those expiring board seats shown with an asterisk. The term of office will run until 1993. The candidates for the five positions to be filled are:

Tom Clark, W3IWI
Pete Eaton, WB9FLW
Greg Jones, WB5IVD
Don Lemley, N4PCR
Bob Nielsen, W6SWE
Harold Price, NK6K
Dave Toth, VE3GYQ

Your ballot is included in this issue of *PSR*. It is included as an insert so that the issue may be kept intact. Please vote for the five candidates of your choice and return the ballot immediately to the TAPR office. The ballot can be folded, sealed and stamped for ease of mailing. All voting must be done by mail. THE BALLOTS MUST BE RECEIVED IN TUCSON NO LATER THAN TUESDAY, FEBRUARY 20, 1990. Election results will be announced at the annual meeting on February 24.

The candidates' background and qualifications as submitted by them are:

TOM CLARK, W3IWI

Tom Clark, W3IWI, has been a director of TAPR since its founding. He is also currently a director of AMSAT and was a founder and former President of that organization. Tom was a member of the TAPR TNC-1 development team and did some of the design work on the TNC-2. He was one of the TAPR team members that developed the TAPR PSK modem. Most recently he has been active in the Microsat development work, having been responsible for the radio receivers for those satellites.

PETE EATON, WB9FLW

Pete Eaton has been involved with Packet since October of 1981. He is a charter member of TAPR and a Director since 1983. He has been a member of the development team for the Beta Board, TNC 1, and the TNC 2. In 1986 he helped write and produce a tutorial video tape which is still in wide distribution. Currently he is TAPR's Executive Vice President and Project Manager of the packetRADIO project. "TAPR's greatest resource is it's people, whose talents are our hobby's most important asset. It has been a pleasure to work with them, and if reelected to the Board, an honor to continue to do so."

GREG JONES, WD5IVD

Licensed since 1978. Working on a masters degree in Computer Science and Computer Information at the University of North Texas in Denton, Texas. Employed by Compaq Computer Corporation - Dallas Engineering as a Technology Planner, responsible for researching future telecommunications directions for Compaq. Member of TAPR, ARRL, AMSAT, Texas VHF/FM Society, Vice President of Texas Packet Radio Society, and editor of the TPRS Quarterly Report. Originally involved with packet through the TNC II project. Involved with the TAPR packetRADIO project - responsible for documentation. Also involved with future development paths for TexNet and TPRS. Have presented papers at the last two ARRL networking conferences as well as the last Dayton convention and TAPR meeting. Addresses : CIS: 72047,3455, BITNET: greg@untvax, UUCP: greg@dept.csci.unt.edu, PACKET: WD5IVD@WA5MWD, PHONE: (817) 382-2005.

DONALD G. LEMLEY JR., N4PCR

Licensed since 1967, Don has been actively involved in the development of packet radio facilities in Illinois. He is currently employed by Tellabs, as an Engineer in the Data Communications Division. Since 1985, Don has made significant contributions to the KA9Q TCP/IP package, including an early port of the software to the Unix environment, and development of Ethernet drivers for Unix versions of NET. Most recently, he has worked to develop PC plug-in cards for high-speed packet radio operation. Don runs a multi-band, multi-port IP/NetRom gateway/switch in the Chicago area, and operates a BBS for Amateur Radio use that is available via phone or packet radio. Don is also involved in the development of a full duplex 56kb link using the WA4DSY modems, intended to upgrade the local Illinois backbone from 9600 baud to 56kb. His other current project is prototyping and test of a new high speed networking card, based on the Motorola 68302. Utilizing a pair of the new processors, this card provides up to 10 ports, 6 of which can run bit rates as high as 6 Mbits/sec. To make this card useful, Don is working with N3EUA to build a standalone version of the KA9Q software for packet switch applications.

As a member of the TAPR board of directors, Don will apply his experience in packet radio development and implementation to the issues that face the organization. He has already demonstrated a strong desire to promote the use of the mode. This desire, coupled with his insight on higher-speed packet technology, will

help keep TAPR at the forefront of amateur packet radio!

BOB NIELSEN, W6SWE

Bob Nielsen, W6SWE, has been a licensed radio amateur since 1952 and holds an Extra Class license. He has a BS in Applied Physics from UCLA and is employed as a Senior Scientist at Hughes Aircraft in Tucson. In the 1960's he participated in the design of Syncom, the world's first synchronous orbit communications satellite and of the VHF repeater on NASA's ATS-1 satellite. He is currently working in the field of radar guidance systems.

His amateur radio interests have included CW, RTTY, DX (DXCC and WAZ) and contesting, as well as packet radio. He has served as an officer of radio clubs in the Los Angeles area and in Tucson, and is a life member of ARRL and an assistant director for the Southwestern Division. Bob has been a TAPR member since 1988 and was recently named editor of *Packet Status Register*.

HAROLD PRICE, NK6K

I have been active in the area of amateur Packet Radio since 1982, and have been a director of TAPR since the first elections in February 1983. Since the summer of 1988, most of my "hobby" time has been spent working with the Microsat and Uosat packet radio satellite software groups. If all goes according to plan, I will have spent half of December at the South American launch site helping to prepare TAPR's first major presence in space (TAPR donated half the funds for the AMSAT-NA microsat). I've helped steer TAPR since its early days, and look forward to continuing to find new ways for our group to contribute to world-wide amateur radio community.

DAVE TOTH, VE3GYQ

Dave has served on the TAPR board for the past 3 years. He is heavily involved in network management on the HF network, as well as the implementation of a dedicated UHF back-bone network in southern Ontario. Previous packet work included co-writing a packet BBS with Hank Oredson, W0RLI; his on-going programming projects involve working on UNIX-based systems to develop more sophisticated network servers/BBS's. Dave has also been involved as a volunteer in AMSAT's Microsat project, which TAPR has also supported. He feels that we are close to breakthroughs in high-speed, micro-wave, and satellite linking, and would like to continue to guide TAPR's course in these technologically challenging areas, with the fine team of volunteers in the TAPR organization.✦

BE SURE TO RETURN YOUR BALLOT!

NOTES FROM THE TAPR OFFICE

Hello! I'm Heather Johnson, N7DZU, (Lyle Johnson, WA7GXD's XYL,) the one who answers the TAPR phone, receives and processes your orders, tries to channel your technical questions appropriately, and attempts very hard to be prompt and dependable in meeting your needs. I enjoy my job.

The TAPR office is now located in our home, and our six children are all in school. If you are on the phone with me at 2:30 in the afternoon, and you hear a door slam, with a cheery "HI MOM" in the background..... well..... they just got home!

There are a few things that I wanted to talk to you about.

First. Did any of you NOT notice the date inconsistencies in PSR #36? The front page had "October" emblazened on it, with the subsequent pages contradicting with "November". (It was actually the October issue.) Guess who was responsible for this oops? Me. Sorry.

Second. A year ago, the TAPR Post Office Box number was changed from 22888 to 12925. For one year the post office faithfully forwarded mail from the old to the new. We are at the second stage now, when they return the mail to the sender. Please remind anyone sending correspondence to us to make sure that they have the correct address! TAPR, PO Box 12925, Tucson, AZ 85732.

Third. The office often receives requests for someone willing to construct, repair, and troubleshoot our kits. TAPR is a volunteer group with no one at this time available to meet this need. The folk requesting this help appear to be willing to pay some reasonable amount for the service. All I need is someone to be able to refer them to!

Fourth. A gentleman wants to locate a "Superterm" or a "Terminal 40 Plus" which was produced by Midwest Micro Associates, Inc. Apparently this is needed for his VIC 20. Do any of you know where he could get this? I also get requests from folk owning other than IBM compatible computers for software, and other Packet related materials, that we do not offer. Any of you working on Apples, Ataris, or Commodore 64's or ??? that could give these fellow hams some help?

Fifth. Do any of you have photographs of TAPR events from the past that I could get a copy of? February meetings, etc. I am in the midst of making a TAPR scrapbook.

Finally. Cris, the previous TAPR secretary, greets you. She is busy and happy with their second child....but also misses you all a little bit!

We both think that amateur radio people are a tremendous group, and in particular, packet radio people! Looking forward to hearing from you, and seeing lots of you at the TAPR Annual Meeting!

73s,
Heather, N7DZU

BITS IN THE BASEMENT

by Bdale Garbee, N3EUA

This issue marks the third time I've written "Bits in the Basement", and to date, the only feedback I've received has been from Andy N0CCZ, who asked me to adapt a copy each time I write for inclusion in the TAPR PSR in addition to the RMPRA>PACKET, which is where the column began. Other than that, the silence has been deafening!

What do *YOU* think? Do you think at all? If so, let me know what you think... I'd like both to be able to tailor this column to your information needs, and to feel like someone out there actually reads this stuff! Enough said...

Neat Stuff in Progress

John Conner, WD0FHG, and I have spent a couple of afternoons working on the 56kb modems since my last report. We've *almost* got everything working. If I hadn't taken off to Japan, and if John hadn't headed for China when I returned, we'd probably be on the air now... The only things left are to build up a couple of supplies to provide 12V and +/-5V for the units, and to repair a wiring error in one of the cables between the DRSI PCPA card and the modems. Hopefully, the next time I report we'll have the units on the air and I can wax poetic about the joys of 56kb operation! Progress on the 10Ghz N6GN project is on hold until John's return from China, we've got preliminary PCB layouts done, and will be building up some prototypes on circuit boards to test the design. N6RCE has reported a problem in the original prototypes that is apparently in the AFC circuit, we'll want to understand and correct the flaw before we proceed further.

A fundamental decision was made at the ARRL Networking Conference here in Colorado Springs to not release any further updates to the pre-NOS version of the KA9Q TCP/IP package. The next release will be the first official public release of the rewritten package known as the "NOS", or New Operating System, version of NET. There will be quite a few changes in the user interface, and changes in all of the configuration files. Thus, user documentation will be even more important than in previous releases, so don't expect this until sometime after the first of the year. Progress on the PS-186 software has been slow, but progress is being made. I have NOS running on the board with the console functioning well. I've not quite got the radio ports working yet, but I'm close. Now, if I could just get a couple hunks of uninterrupted time to work on the code...

Kantronics has promised me one of the alpha-revision de56 boards that they were showing at the ARRL Conference here in Colorado Springs in October. This is a V40-based dual-port data engine for packet. I intend to put essentially the same code on it that I'm working on for the PS-186, offering a choice in packet switch platforms based on the KA9Q NOS package. As I write this, the unit is supposedly on the way, so I should have more to report next time.

The DRSI implementation of the K3MC Awesome I/O card was much discussed at the conference also. DRSI had plots of the PCB artwork to show, and I understand the board is nearly ready to go into production. As I've mentioned before, I hope to port the NOS code to this board too for standalone use. Meanwhile, Kevin N6RCE has been working with one of the initial wire-wrapped copies of the board, writing drivers for the KA9Q package for use as an end-user interface.

Packet Radio in Japan

Two years ago or so, in January of 1988, I just happened to be in Japan on a business trip the weekend of a meeting of all the packet radio groups in Japan. I stumbled on the meeting when I contacted Takayuki Kushida, JG1SLY, when I arrived in Tokyo. I had his name and number as one of the 2 or 3 people who had requested copies of the KA9Q TCP/IP package from Andy N0CCZ when Andy was handling distribution of the floppies. This was on a Friday. He told me that he was driving the next day to Hamamatsu for the meeting, that he had been asked to talk about the KA9Q package (which was brand-new to Japan!), and that I simply must go with him. Well, to make a long story short, I went, and spent a most enjoyable weekend as the co-guest of honor, alongside Hank, W0RLI who was their invited guest for the event. I met many interesting people, including several officers of the then-fledgling organization PRUG. Since that time, the Packet Radio Users Group of Japan has grown in size, and last year invited Harold Price, NK6K, to attend on behalf of TAPR. Harold was author and maintainer of much of the AX.25 code for the TNC-1, and is currently involved in writing much of the software for the Microsat project. This year they hosted a similar meeting near the city of Fukushima in northern Japan. Much to my surprise, they invited me back as their guest, to talk about TCP/IP, 10Ghz operation, and the other exciting things happening in packet in this country. My wife Karen, N1FED and I spent the first 11 days of November in Fukushima, Kyoto, and Tokyo. We learned a great deal about Japan, and the packet radio activities there. A couple of things in particular are worth reporting. The thing that impressed me the most about PRUG is their organization. By this, I mean their ability to get a *lot* of folks actively involved. There are now over 100 people running TCP/IP in Japan, mostly centered around Tokyo. Dai Yokota, JK1LOT, has written a major new application for the package that provides Usenet-style news capability, and it is in heavy use, generating approximately 100 new messages per day in the various discussion groups. The group has translated much of the user documentation into Japanese, and one member has converted the document to TEX source format and created a really nice-looking version of the English docs, which they've promised to send me to use as the basis for the next release of the user manual.

Members of the organization have developed a 9600-baud modem based on V.29 FAX machine modem chips from Yamaha, and over 300 kits have been sold, about 100 of which are on the air and working today. Using FAX chips for packet is neat, but there are both advantages and disadvantages over the approach that TAPR is taking with the FSK packetRADIO project. One of the biggest problems with contemporary packet operation is the varying equalization in off-the-shelf VHF/UHF radio gear. It is a royal pain

to properly adjust a given TNC/Radio pair, particularly at higher speeds. The V.29 FAX chips include an auto-equalization feature, designed to compensate for variations in the audio quality of the telephone lines used for FAX transmission. Not surprisingly, these chips also work very well on radio links. Unfortunately, the equalization process includes the transmission of a 'training' sequence every time you turn the transmitter on (which with phone-line FAX is once per page, but in our application is once per packet!), so that the receiver can listen and adjust the audio to match the expected characteristics of the training sequence.

What this means is that the TXDELAY has to be set to about 250ms with these modems in order for the radios to do their 10-30ms of normal warmup time, followed by the 200ms or so training sequence... with short packets, you spend as much time equalizing as sending data! Obviously, the overhead is less apparent with larger packet sizes. To me, this is a strong negative, at least on a theoretical level, to widespread use of this technology in the US. The upside is that the modem interfaces to any off the shelf radio through the speaker and microphone connectors, just like a 1200 baud TNC. PRUG has generated a small printed circuit board to hold the Yamaha chip and the small set of related components, that mounts on the TAPR-standard modem disconnect header. It's all very clean, and very quick and easy to get on the air, and if nothing else it means that they can hop onto and populate a new band or frequency with 9600 baud packet as easily as buying a new rig and pluging things in. I should note that the fundamental problem that is solved by the adaptive equalization (different radios having different equalizations) is also solved by the TAPR packetRADIO... since the unit includes a modem and RF assembly as a single unit, designed together, optimized for packet, and aligned to a standard deviation, etc. Thus, in some ways the two approaches to 9600 baud are equivalent... to me the big win of the Japanese FAX approach is that they're on the air now, on several bands. The big win of the TAPR FSK approach is that TXDELAY is reasonably short, and the completed unit will be cheaper than a modern VHF/UHF rig combined with the FAX module.

PRUG has promised to send me a pair of the units for testing, one of the questions they were unable to answer was how well the units would work on long, lossy RF paths... V.29 requires a fairly high signal to noise ratio. Because of the population density in Japan, and the number of hams on the air, the average paths are single-digit numbers of miles... quite a different environment than here in Colorado! The use of the 1.2Ghz band for packet has grown dramatically in Japan, with several 1200 and 9600 baud channels in use. I was, in general, very excited by the amount of commercial 1.2Ghz hardware that was available. All the big names in amateur RF had gear, including 70cm/1.2Ghz dual-band gear, that was pretty neat! And as N6GN has so often pointed out, the higher you go in frequency, the more antenna gain you can get for a given volume of occupied space... some of the commercially manufactured yagi arrays were quite spectacular! My friends pointed out that 1.2Ghz, even in Japan, is mostly used in the heavily populated areas, like Tokyo, where there are 12 million people in the city, and about 40 million people in the surrounding area. It was fascinating to visit the PRUG club shack, and hear *lots* of packet channels hammering away... they claimed to have 25 channels in use in Tokyo with a mix of 1200 and 9600 baud on 70cm and 1.2Ghz... a far cry from what I'm accustomed to here in the Rockies! Of great interest to me, not only because of my involvement with N6GN and N6RCE in the 10Ghz work they reported on in the 12/89 issue of Ham Radio, were PRUG experiments being performed with 10Mbit/sec data rates on 10Ghz using modified fast-scan ATV IF boards, gunnplexers, and PC Ethernet cards. I was fascinated, because the design looked like a classic transceiver design, only at 10Ghz. Separate NEC radar-gun modules were being used for the transmitter exciter and the receiver front end. I'm afraid I stole a bit of their thunder when I put some block diagrams of N6GN's design up on the overhead projector before they reported on their progress. After asking a bunch of questions and studying the schematics I took along, I got the impression they had realized how much simpler (and cheaper!) Glenn's approach is to the problem, and it wouldn't surprise me if they duplicate several sets of our gear and work from there. If we did the Yen to Dollar conversions right, their approach costs about $3000 per unit if you buy all new parts, and we believe you could build our setup for $150 per end with a dish. We'll just have to see what happens! It was constantly fascinating to me how hard the folks in Japan would work to take an idea and make it real... and equally fascinating to see how information-starved they feel about what is happening in the US. The sad part is that that we are equally information-starved about what is happening in Japan. There is a movement afoot within PRUG to document in writing more of the progress on their projects, and there was much discussion about how to get things translated into English and submitted to the ARRL digital conference for inclusion in the proceedings, and about how they might become active contributors to some of our newletters and magazines.

It's interesting to remember that after my first trip to Japan, W0RLI commented to me that he thought the state of the practice in packet radio in Japan was maybe 2 years behind the US. I very much agreed with him. On this trip, I was startled to realize that in 2 years, they have very much caught up with us! It will be extremely interesting to watch what happens in the near future. I believe it will be increasingly important for us to communicate and work with our friends in Japan, lest we find ourselves once again stumbling in the face of the Japanese work ethic. Who knows? Before long, we in the US are likely to be the ones frustrated by having to translate the latest poop on leading-edge projects... Until next time, take a deep breath and then MAKE THINGS HAPPEN! And when you have a spare minute, please write and let me know what you think of the column, and tell me what you'd like to see me talk about in the future. I can be reached as bdale@col.hp.com on the Internet, or as N3EUA @ KA0WIE on the PBBS forwarding network.✦

PACKET AND THE CALIFORNIA EARTHQUAKE

by Lew Jenkins, N6VV

As of today Thursday October 26th, things have started to return to normal around the San Francisco Bay Area. We have learned a lot about the handling of emergency information and Health & Welfare traffic via packet radio.

I thought I would try to get down my thoughts about the performance of packet radio and lessons learned from the recent emergency created by the earthquake while the impressions are still fresh in my mind.

Background

The Northern California Packet Association (NCPA) is comprised of an extensive network made up of hilltop node locations and over 30 BBS systems spread from Redding in the far northern part of the state to Kern County in the central part of the state.

The BBS forwarding system employs a 220 MHz and 433 MHz backbone which utilizes 5 mountain top sites and 5 LAN Gateway BBS's. The theory is that each of the 5 LAN BBS systems serve a number of other BBS's on their LAN. The LANs are:

- North Bay / W6PW
- Sacramento Valley / WA6RDH
- Santa Cruz / N6IYA
- East Bay / N6VV
- South Bay / WB6ASR

The LAN which I am part of connects into the Central Valley Backbone which runs the length of the Great Central Valley of California from Southern California to the Oregon Backbone. As a LAN Gateway station, I am responsible for forwarding to the other LAN Gateway stations and to the BBS's on my LAN, which include: W6FGC, WO6Y, KJ6FY, WB6V, K6RAU, N6OA, WB6ODZ, WB6MIF, and N6ECP. In addition, since my local node is on the Central Valley backbone I also forward north to AL7IN in Oregon and south to K6IYK in Los Angeles.

Network Redundancy

The Central Valley 220 Backbone is one of 2 trunks to the south. The other is down the Coast Route from WB6ASR and AA4RE.

Recognizing the need for redundancy in the network, a number of backup routes have been created and we have had to use these many times in the past. For example last year, during the heavy fire season, a fire on Mt. Vaca took out the Sacramento Valley LAN backbone node WA6RDH-11.

To maintain communications Dennis, WA6RDH had added a 223.54 port on his BBS to be able to communicate directly with N6VV on the East Bay LAN frequency and to be able to pass Inter-LAN traffic without going through the backbone.

In addition, when selecting 2 meter nodes, considerable planning went into choosing frequencies to provide alternate paths in the event of the loss of the backbone. Most of the nodes in use in this area are triple or quad port nodes and include 2 meter access into the network. Strategic selection of 2 meter frequencies has given us the backup which was put to good use during the emergency. More on this later.

N6VV BBS

The N6VV BBS is a 6 port system operating on the following frequencies: 144.99, 223.54, 433.41, 441.50, 14.109, and 21.097. I operate on 2 HF frequencies and provide in addition to N6IYA (14098), N6OA (14107), KB6IRS (14107), and N6EEG (10149), the HF Gateway access to the Northern California area.

The system is an IBM PC/AT with 2 MegaBytes and a 20 Meg hard drive. On normal months I handle between 9 and 13,000 messages per month.

BBS forwarding access into our area is therefore via one of the HF Gateway stations listed above or via the 2 southbound 220 links into Los Angeles and the single 220/433 link north to Oregon.

Tuesday the 17th of October

Like everyone else around here, I spent a considerable amount of time on that Tuesday trying to get tickets to the World Series but by 3:00 PM had decided that I was going to have to be content with just watching the Series on television that evening. At about 4:30, I and most of the rest of the office started to migrate towards the exits in order to make it home in time for the TV coverage of the Series which was scheduled to start at 5:00 PM local time.

Incidentally, everyone around here is convinced that the World Series saved literally hundreds of lives at places like the Cypress Structure on Highway 880, since many thousands of people around the Bay were doing exactly what we were doing, trying to make it home before 5:00 PM to watch the game. I have driven the 880 stretch that collapsed many times and at 5:00 PM during the height of rush hour there would normally have been hundreds of cars jammed into that 12 block section which collapsed.

I work in Concord only 3 miles from my home in Pleasant Hill, so I arrived home about 4:45 and walked out to the shack located about 100 feet behind my house to check the BBS, as is my usual habit when coming home.

I was browsing through the messages going and coming on the system, when suddenly shortly after 5:00 PM my chair started to bounce up and down. At first I thought it was just one of the many little earthquakes that any native Californian has grown accustomed to riding out, with little concern.

Suddenly, the motion began to get much more violent and things began flying around the shack. A large bookcase to my left fell over and spilled hundreds of books and QST's across the floor. Loud noises from stuff falling over in my storage area behind the shack convinced me it was time to get out of the building. I dashed for the door and stood just outside the shack looking up at my tower. My main concern at this moment was the tower immediately over my head. The Rohn 45 tower had a 6 element KLM 20M beam and a 4 element KLM 40M beam at 85 feet. The Phillistrand guy wires were alternately snapping and going slack and the beams were jiggling wildly.

I decided it was probably prudent to try to get at least 85 feet away from the immediate area. Dashing through my back yard to scoop up my 8 year old son, we went to the front yard and watched the trees and telephone poles waving wildly in the air. I live on a small knoll and have an excellent view out across the Diablo Valley. For another 10 seconds we stood watching the eerie sight as the whole valley jiggled and shook.

For about 30 seconds we stood there afraid to move. After checking with the

rest of the family to see that they were all safe, I ran back to the shack to see if it was OK. The power was off and sirens were already screaming all over the area. My neighbors were all out in the streets and some people had their car radios on listening to the first reports. The first serious damage reports were coming in and I heard that part of the Bay Bridge had collapsed.

My first thought was power. I got out my generator and started setting up on the road next to my shack. My neighbors came over and helped me with the gasoline. I started the generator and let it run for a while to settle down. I got out my hand held and began to monitor the 2 meter repeater in our area. There was a lot of conversation on the air as the hams began to check in. This was a good sign since the repeater is co-located with the nodes that I use for forwarding. It is at a County site which has emergency power, so I assumed that it would be on the air.

In a few minutes I had the VHF/UHF side of the BBS going. Another ham, WA6HAM - Steve, was bringing over another generator to get the HF station going. The first step was to find out what nodes and BBS's were on the air. I began working my way through the network to find out who was there. To my horror, W6PW in San Francisco did not respond. In addition the Southbay LAN backbone node on Crystal Peak did not seem to be on. N6IYA, the Santa Cruz LAN Gateway was not there. I started to get worried but was hopeful that it was just power that prevented them from being on the air. The Sacremento Valley stations including WA6RDH were up and the Central Valley guys and circuits all seemed to be OK.

Without hearing any real news reports I began to assume that the worst areas were San Francisco and particularly the Santa Cruz and Gilroy areas. It turned out that I was right. I began working my way through the Santa Cruz BBS's which I do not normally forward to because of our LAN Gateway structure, when suddenly I got a connect with N6MPW. At least one BBS in that area was on. I started receiving messages from the other SysOps who were doing the same thing I was. We spent the first hour or two trying to put our network back together. WD6CMU from the Northbay LAN sent around a message saying he was taking over Gateway duties for the Northbay LAN. N6MPW took over gateway duties for the Santa Cruz LAN. That meant 4 of the 5 LANs were covered, but we still had no word from Roy AA4RE or Greg WB6ASR from the Southbay LAN. We later learned that the Crystal nodes had received severe damage since they were so close to the epicenter.

Emergency Plans Activated

I contacted Brad, WA6AEO, who is the control SysOp for most of our nodes in Contra Costa County and suggested that we put some of our emergency plans into place. We had already set up one node in the south part of the county on 144.93 which was WB6ASR's user port frequency but I could not raise Greg on that port. We were able to move our Berkeley node on BALD to 144.99 which is the user port frequency of both W6PW and AA4RE. This would provide an alternate path for Roy into the network while his 220 access was down.

The channel selection of 2 meter nodes and the frequency agility proved to be vital in reestablishing paths to these locations since Roy has returned to the air and at this time is still using the BALD 144.99 node as his access to the network.

That was the first lesson learned. HAVE SOME BACKUP PLANS for alternate paths when backbone nodes go away! In our case it worked and all 5 LANs were back on the air within hours of the quake.

I started to compile a list of BBS's that were on and began to modify my forward files to get traffic to the right general area. Thankfully, N6LDL was reachable on the 2 meter Northbay port of 144.97 and I set him up to receive all San Jose and Los Gatos ZIP's. WD6CMU was taking all the Northbay LAN ZIP's and N6MPW was taking Santa Cruz. One thing I learned during this rework of the forward files was that I would have been better off to have had independent files set up by BBS instead of by LAN; it was a painstaking process rekeying all of the ZIP information. In that way I could have just moved my files around by BBS to reflect the crazy 2 meter forwarding patterns which evolved during the emergency.

By this time the other generator had arrived and I was now up on 20 Meters on the 14109 NET. It was getting fairly late and I just had enough time to fire off a message to Dave, W9ZRX, that I was on before the band closed up. Sometime around this time K6IYK in Los Angeles connected to me and told me that the Coast route was gone but that the Central Valley 220 route had survived and to expect lots of NTS traffic. I gave him a brief rundown on the situation and told him that we were ready.

By now traffic was starting to flow all around the network and Health and Welfare stuff was starting to come in from AL7IN in Oregon and K6IYK in Los Angeles. We sent out bulletins calling for a halt to ALL non-essential bulletins on the network and I composed messages for the HF Networks requesting the same thing.

Listening to the 2 meter and UHF repeaters into the Santa Cruz area, it became apparent that the voice circuits were a zoo and that if any H&W traffic was going to make it into that area it was going to have to be on packet.

The surviving repeaters were all tied up with tactical information and most of the net control stations did not want to hear about Health and Welfare traffic. Actual fights broke out on some of the repeaters over the handling of H&W traffic and I was very pleased when I started to hear people on the repeaters tell people "PUT IT ON PACKET." We let them know that we had established routes into all the affected areas and we started to see traffic coming in from the outlying areas from operators who seemed to be taking H&W traffic off of the 20M nets and dumping it onto the local BBS system.

From my own experience I can tell you that phone service into the 408 area code was very spotty and some areas in the Southbay were not available. HF SSB stations taking traffic for these areas had no way to deliver the traffic and most ended up just dumping the traffic into the local BBS system anyway. Area code 415 was not bad after about 12 hours and service was returning within 24 to many areas; but I tried all night to reach the Santa Cruz BBS's by phone and could not get through. All during this period I was forwarding packet traffic for hours on end to N6MPW in Santa Cruz!

By 4AM in the morning I realized that I would have to also modify my outbound forward files and adopted the theory that I should just try to get the traffic out to anybody who could take it. I made heavy modifications to my forward files to get as much traffic to W9ZRX and W3IWI who are usually my best connects on 20 and 15 meters.

Flood of Traffic

As the sun came up and the HF bands started to come alive, the traffic began to pour in. ZRX connected to me and had a 2 hour forwarding session. The inbound volumes were unbelievable. At some times I had W9ZRX on 20M, W3IWI on 15M, K6IYK from So. Cal. on the 220 port, AL7IN from Oregon on the 433 port all forwarding to me at the same time. I only had 2 outbound ports to try to handle the 4 inbound ports which never stopped. I called for help and remote SysOps Brad WA6AEO and Dennis KA6FUB came over to the station; for the next 48 hours the BBS here was fully manned around the clock. We never went through a normal forwarding cycle but had to use force forwards to try to keep up with the imbalance in inbound/outbound traffic. The number of messages on the board kept increasing since we could not keep up with it. I believe that the peak came on Wednesday night with a total of about 800 active messages on the system. Many hours earlier I had deleted all my bulletins so all of these messages were NTS.

By the weekend we had handled over 5000 messages which had mostly been forwarded into the Santa Cruz and Bay Areas. We had recruited a core of local hams to check in and handle the NTS traffic destined for our area, but even that was getting out of control. I was actually outside the seriously affected area and had power and phones back by the end of the first night, so I could imagine that the guys like N6MPW and W6PW were really starting to get jammed up.

I started to receive messages from several SysOps that they wanted me to stop sending them traffic, and one night got a call from Larry WB9LOZ, SysOp at W6PW that he already had 700 NTS messages backed up and could I just stop for a while. I explained to him that the message flow was like a freight train and that we could not just stop at certain points but would have to stop the whole flow. If I stopped forwarding out to the destination BBS's, I would have thousands of messages here and ultimately blow up. We would have to shut it off farther back stream or just shut down the gateways.

We tried to contact KA6ETB the NCN Packet coordinator to see if we should send out a national bulletin asking everyone to please slow down the H&W and eventually one was originated. I knew that it would take several days for an @USA bulletin to make it around sufficiently to have any effect so we had no alternative but to keep on forwarding.

We need to think more about this flood problem and figure out a better solution. I am sure we will be discussing it heavily in the future but we did the best we could in the first 3 days after the quake.

One important lesson learned here in the San Francisco area is that packet turned out to be the most efficient means of delivering H&W traffic; and while I have not heard the numbers from other gateway stations, I am now over 6000 pieces of traffic since the quake and I am sure the total will be in excess of 10,000 messages handled via packet. This is quite impressive since this is a tremendous increase in normal packet traffic and the software, systems, network, and operators were able to respond wonderfully to this flood of traffic.

I have heard horror stories from the guys who were handling H&W on the HF SSB Bands about jamming and poor organization. I am happy to tell you that other than the normal RTTY Jammers on 21097 (they don't like us there) we were able to move tremendous volumes of messages on HF Packet.

Lessons Learned

1. You need to have a backup plan. I list this one first because we had a plan of sorts but had to make a lot of it up as we went.

2. Packet is wonderfully adapted to handling very high volumes of Health and Welfare traffic during emergencies, but probably shouldn't be used for tactical information handling. Voice circuits are better and the packet channels get jammed up with H&W anyway.

3. Because of networking possibilities, packet networks can respond better than any other form of Ham Communications to changes in the emergency situations. We completely rerouted traffic throughout the entire system in less than 3 hours.

4. We need a quicker way to handle network management bulletins. Maybe we need an emergency bulletin designator that EVERYONE supports, but is not used except under extreme emergency.

5. Every ham who uses a packet bulletin board should become familiar with packet NTS procedures. Under circumstances like this you have to get anyone with a TNC involved to handle the traffic. The vast majority of traffic handled locally at N6VV was NOT handled by our normal NTS liaison people. We were recruiting people off the 2 meter repeaters to help. Fortunately we had a file called HOWTO.NTS in the file section that these people were able to download and read. Instant NTS handlers! *[HOWTO.NTS is available for downloading from the HamNet forum, data library 9, on CompuServe.]* Many of the regular NTS people were working 24 hours a day in Red Cross facilities or emergency centers and never did check in to a BBS. Even with the thousands of hams in this area, we did not seem to have enough to go around. The emergency sites were recruiting hams from as far away as Sacramento to man sites in Santa Cruz.

6. A major problem we had on this end was misaddressed or non-addressed traffic that required manual intervention before it would flow through the automated forwarding system. I only had 3 hours sleep by Friday night and the main reason was fixing this mail. Mail simply addressed NTSCA @ NTSCA with no further information was being received here. Each message like this required us to read them and in some cases to have a USPS ZIP code book lookup to get them on their way. When you are dealing with thousands of messages this can be a tedious job. I actually received personal mail addressed N6VV @ N6VV with a list of 25 friends they wanted me to contact. These BOOK type messages simply DO NOT WORK in the packet environment and require far too much manual intervention at the disaster site.

All NTS traffic here, and I thought elsewhere, was ZIP code routed. Personal mail is routed by BBS and ZIP code does not work for it, but the NTS ZIP delivery system is well established and each NCPA BBS is provided with a complete list of zip codes for all of northern California and where they are supposed to be delivered.

Messages received without ZIP code sit idle until manual intervention.

These are just some of the lessons which we have learned. I am sure many more will be thought of, in our after action meetings.

In summary, I think that the San Francisco Earthquake was the first great test for this new technology which we call packet, and although I'm sure we will be able to find some faults, in general, packet performed wonderfully under what at times seemed like an impossible situation. My thanks to all the SysOps around the country who helped.

An interesting sidebar. All of these thousands of messages that were delivered were transmitted on 220.90 MHz. I can only hope that UPS will be able to utilize that frequency as effectively as we hams did during the Quake of '89.✦

packetRADIO PROGRESS REPORT

by Deep Inductor

TNC

The internal TNC will be 4-layer, the parts for the TNC will cost about the same as the TNC 1 Upgrade boards, perhaps a little less. We are bypassing the RS-232 lines with .001 uF caps to ground, this should make things real quiet.

The TNC has the normal 5 LED's on the front and the DE9S on the rear of the board. Power and I/O otherwise occurs through the modem disconnect header, which uses the PacComm 26-pin expanded header to route the +12 volts in from the digital board. This way the internal radio harness remains constant and to add the TNC you only have to plug it in and tighten the four mounting screws, no wiring changes are needed!

The TNC measures 4.0 by 6.8 inches and the layout is fairly open for easy construction, we have tried to keep the higher speed traces close to the same area of the board (clock oscillator and CPU/SIO/memory decoder/memory chips). The rest of the board kind of fell where it would. The charge pump for the RS-232 is next to the RS-232 chip. The DE9S immediately feeds bypass caps, then series resistors, then more bypass caps. A ground plane is fed to a single point ground for the RS-232 and digital stuff.

Finally, we hope to have the TNC relayed out by the first week of December and the digital board a week after that. We want to fire this puppy up over Christmas!

The TNC schematic is completed (naturally there will be changes as the layout progresses - swapping gate sections and pins, that sort of thing). The TNC has battery-backed RAM, provision for bankswitching a 27512 or just using a standard 27256 EPROM, an 8-bit output port for controlling the radio, a 9-pin RS-232 connector with a jumper for NET/ROM multi-port activation (seems like a NET/ROM cluster might make sense for this thing), NRZ to NRZI hardware, etc.

The TNC layout has the Z80 CPU, SIO, RAM, and EPROM layed out and connected, and the other IC's in the "kernel" placed.

Motorola has announced the MC145407 RS-232 part which is the 145406 we are now using plus a 5-volt power supply. This is a MAX232 with an extra driver and receiver. Samples are coming and if the price/availability is right we will design this one onto the radio TNC instead of the MAX680/MC145406 combo now being used.

Digital/Modem

The "digital" board will be 2-sided, the parts cost is not known yet, it depends on the cost of the switches. By going to a mechanical rotary switch for crystal selection, the radio can operate without the TNC. This also eliminates the need for a default setting in case of power failure (and the radio is on top of a snow covered mountain!).

There will be room on the digital board for the XR2211 demodulator, if the receiver board gets too crowded, so we hopefully won't have to expand the box.

Intersil/GE make an AD7523 D/A which is an r-2r network, CMOS, 0.2% accurate and costs only $2.50. We will use this for the digital board D/A layout for the first cut, individual resistors can be patched in the same space for testing purposes as well; samples are enroute.

We will be using either (a) a MAX680 charge pump and a Motorola MC145406 RS-232 chip or (b) a Motorola MC145407 chip. The MAX232 only has 2 drivers and 2 receivers and we need 3 of each for a TNC/MODEM - have to have 1 pair for data, 1 pair for handshaking and 1 driver for DCD out ("connected") and one receiver for "am I a NET/ROM bussed to other NET/ROM's on my serial port?" signal.

A female DE9 will be wired as modem, it will connect directly from a "standard" IBM AT 9-pin serial port using a straight-through male-to-female cable. It is recommended that you don't use a ribbon cable unless it is shielded!

The modem generates the clock, in fact the wiring is set up so the unit will ignore a user-supplied clock.

Local Oscillator Board

The LO board was first photoplotted and checked, then prototyped; the revised Gerber files are at the CAD house and should be back and proofed by the first of December, if they look good, we'll get them into production.

Exciter

The exciter board will need to be revised and prototyped as will the PA board. Time is being spent to assure sufficent drive for the PA as well as characterizing the exciter.

Receiver

The receiver has been throughly tested from the RF input to the second mixer. The front end of the receiver is performing to design specifications (17 dB of gain is provided at an overall intercept point of -2 dBm).

The discriminator has been changed from a crystal to a quadrature coil, two poles of IF filtering have also been removed. These modifications were made to reduce costs without degrading performance.

The intent is to get six (6) boards from each prototype run, cut and hacked as necessary, iron the bugs out, go to replot and get the beta radios produced.✦

STAR TREK IV PACKETS?

by Bob McGwier, N4HY

Several months ago, Harold Price, NK6K, challenged me to demodulate what he thought might be HF packets in Star Trek IV. During the scenes where Scotty is valiantly trying to beam both Chekov and Uhura back from the U.S.S. Enterprise, where they have been stealing Nuclear vessel high speed photons, Scotty is having a hard time hearing them. One of the sources of interference is what appeared, to Harold, to be HF packet. Always being one to rise to a challenge, I took on the job of doing some fancy Digital Signal Processing footwork. Almost from the first I was certain that it must be an HF packet since my very first demodulator attempt clearly revealed flags before the start of a frame and end-of-frame was also clear. I knew it was HDLC of some variety. Several things impeded the effort, including Scotty's voice on top of the packets, some SSB from 20 meters was also nearly on top of the signal. All of this had to be filtered out. I spent an hour of time on the Cray-2 at work and used the fanciest FSK demodulator I could write and I finally had a noisy baseband signal plotted on paper in front of me. I did my best to get an integral number of samples per baud as the signal was very noisy, and though the bits could be made out by eye, I could tell that it was going to take another hour of Cray-2 time to get the clock recovered and to make good bit decisions. In a couple of places, HDLC showed me what were clearly bit errors, and these could be done by eye as well. After the filtering, and building a demodulator for the badly mistuned signal (it was almost 900 Hz below 'normal'), I took the bits to Phil Karn, KA9Q and he decoded the NRZI data and proved beyond a shadow of a doubt that it was indeed an HF amateur radio packet. It was WA8ZCN-0 sending an RR for NR-3 to N6AEZ on 20 meters. I got Bill Harrigill, WA8ZCN on the phone and he agrees that it was probably him. Thanks Harold for the challenge and Phil for the help.✦

Report of the ARRL Digital Committee

by Paul Newland, AD7I

The ARRL Committee on Amateur Radio Digital Communications met over the weekend of October 7-8 in Colorado Springs (concurrent with the Networking Conference at the Air Force Academy). The primary topic of the meeting was new development for HF packet. Paul Rinaldo, W4RI, the chairman of the Committee and also editor of QST, reported that the ARRL has received a $10,000 grant that it requested from the Federal Emergency Management Agency (FEMA), specifically for HF packet modem and protocol development. The grant covers a two year period ending in September, 1991, at which time the final report must be submitted to FEMA. These funds are to be used only to reimburse "out of pocket" expenses (i.e., to purchase hardware and perhaps travel but not to pay for peoples' time). The Committee and audience discussed major areas of HF packet that needed improvement. Four main topics came out of that discussion:

- modem design improvements
- protocol design improvements
- diversity to reduce the effects of multipath
- network management to reduce collisions

Paul informed the Committee that many people (about 40) had contacted the ARRL and said they were interested in HF packet development and FEMA's offer of financial support. The Committee agreed to form a subcommittee of Paul Rinaldo, Eric Scase and Paul Newland to meet on December 9th to complete work on the specific design goals for the HF packet program. Paul also told the Committee and the audience about the ARRL's two Technology funds. The Starr Technology Fund was established specifically to improve HF packet radio and presently has slightly over $3,000. The Rinaldo Technology Fund has a broader scope and can be used for any technical developmental work in Amateur Radio, including HF packet radio; it also has slightly over $3,000. As an aside, if you wonder why Paul's name is on the "Rinaldo" fund, that's because he donated $3,000 of his personal money to the fund to ensure that there is a source of money available for amateur radio technology development. That's really putting your money where your heart is.

Thanks Paul!
de AD7I

FROM THE EDITOR

by Bob Nielsen, W6SWE

Hi folks, after several years, *PSR* is originating in Tucson again. I'm your new *PSR* editor and I hope to maintain the high standard that *PSR* is known for. Among other things, we are going through a transition from Pagemaker on the Macintosh to Ventura Publisher on a PC.

Scott's a tough act to follow (Greg, too for the last issue), but I have a lot of help. Bob Hansen, N2GDE, of Elmira NY is doing a large part of the work as co-editor with the actual layout of each issue. I'm gathering up all the inputs as well as arranging for the printing and mailing, with a lot of help from our TAPR office manager, Heather Johnson, N7DZU.

But we need even more help! That's where you come in. Technical articles, news of what's happening around the country and the globe, operating hints, comments, letters, you name it. If you have anything that you want to share with your fellow packeteers, send it to me:

Bob Nielsen, W6SWE
1400 E. Camino de la Sombra
Tucson, AZ 85718-3915
or via packet to W6SWE @ W1FJI.AZ
or via CompuServe to: 71540,2364.

MICROSAT STATUS UPDATE

by Bob McGwier, N4HY

It is time again for a status report before we ship the Microsat birds to Kourou. The team leaves on December 1 from Colorado with the satellites. Various other team members will travel from around the world to the launch site in French Guiana on the northern coast of South America.

The latest official launch date from Arianespace is January 9, 1990 at 0140 UTC plus or minus a few minutes. Four Microsats and two UOSAT birds will ride on a small satellite shelf designed for missions such as ours under the Spot-2 satellite. The launch window is determined by need for the primary mission, Spot-2, to be in a given sun-synchronous orbit. This will bring Spot-2, the Microsats, and the UOSATs overhead at about the same time each morning and evening.

Spot-2 is an earth resources satellite with a high resolution camera. The Microsats include two packet radio satellites, PACSAT and LUSAT, a camera and experiment satellite WEBERSAT, and a voice encoder educational satellite called DOVE (Digital Orbiting Voice Encoder). PACSAT is sponsored by AMSAT-NA and TAPR. LUSAT is sponsored by AMSAT Argentina. WEBERSAT is sponsored by the Center for Aerospace Sciences and Technology at Weber State College in Utah. DOVE is sponsored by Junior De Castro, PY2BJO, and Brazil AMSAT. All spacecraft had contributions made to them by the ARRL and its lab staff. The UOSAT satellites are done by the University of Surrey and are in the continuing tradition of UOSAT-9 and UOSAT-11.

This past week saw the finishing touches put on the initial flight software load. NK6K and N4HY worked on finishing off the software. Harold Price, NK6K finished the kernel, initial AX.25 software, the software loader, and the memory wash (to correct for radiation induced errors). Bob McGwier, N4HY finished the initial control code for each satellite.

On Thanksgiving day, N4HY, Jan King, W3GEY, Jeff Zerr, and Greg Hines, WT0M began making the final telemetry calibrations, and final testing of the battery charge regulation control loop, and the transmitter power control algorithm. All four Microsats had their algorithms extensively tested and the spacecraft were left running for days. The algorithms were run under simulation by simulating the solar arrays with a current limited power supply, various timers to simulate eclipses, and beginning from various states of battery charge. In every case, the overdamped control loops behaved perfectly. The hardware was extensively exercised under command code using AX.25 packets from a normal TNC. Various transmitters, experiments, etc. were tested. NK6K's memory wash routines and software loaders were repeatedly used without fault.

At last, an end to end test, from ground station to algorithm controlling the DOVE voice experiments, was performed. The Motorola 68HC11 in the DOVE module, acting as a very smart UART chip, was sent a program from the spacecraft IHU and it then ran the digital to analog converter (DAC). This provided an end to end test on both hardware and software that until this test had been run, had never been exercised as a system. It was a working testimonial to the modular approach taken in the spacecraft design. On Tuesday, a program to exercise the digitalker, the VOTRAX SC-02 chip, was loaded and speech was produced from the DOVE spacecraft for the first time. The entire DOVE speech hardware has now been shown to produce the correct signals and signal levels. This will promise to be an extremely loud signal with a 4 watt transmitter and 4 Khz deviation.

CAST had WEBERSAT the week preceding these tests. They tested all the experiments on their 'attic' which sits on top of a normal Microsat configuration. During this period and the last testing that occured in Boulder, several pictures have been taken and downloaded via the packet channel. The camera produces very good pictures and the mechanical iris functions well. The extensive environmental testing that was done appears to have done no damage to the iris. This promises to be an extremely popular bird and satellite to watch (pun intended). Other than a minor accident requiring several hours of work to repair, these tests went off without a hitch.

Finally, after several days of running the control algorithms on the spacecraft, after all spacecraft passed all their memory tests verifying a total of 32 Megabytes of storage, the control algorithms functioned appropriately, telemetry calibrated, and AX.25 being used to command the spacecraft, Jan King, W3GEY, project manager exclaimed that we had four live spacecraft, ready to begin on orbit operations.

There will be an extensive engineering test phase immediately after launch. It is vital that we have the cooperation of the amateur radio community. We must fine tune control algorithms in space, finish off the BBS code, hundreds of thousands of kilobytes of digitized voice must be uploaded to DOVE, and hours of upload of camera software to WEBERSAT must be accomplished. NK6K and N4HY will be spending numerous hours each day at their QTH's and at the TRW radio club in Redondo Beach, Ca. getting the spacecraft fully loaded with software and taking the pulse of the spacecraft. In addition to the Microsats, NK6K and WB6YMH, Skip Hansen (who has written the low level I/O drivers for the Microsats), have extensive software responsibility for UOSAT. This promises to be a busy time for all.

If the spacecraft are launched on time in January, do not expect full operations to begin before LATE FEBRUARY. Your cooperation will speed the process and possibly lead to an early release of these spacecraft for full use.

[The following was received just before the PSR deadline.]

News From Kourou

The Microsats and the team have arrived at the launch site in good shape. Though the boxes took a beating, the spacecraft themselves seem to be in good shape. We are counting ourselves lucky as the UOSAT team arrived sans one UOSAT satellite as it had been left behind at ORLY airport by baggage MIS-handlers. We certainly hope that this all gets straightened out soon. The process of setting up equipment, test equipment, etc. is going on

now and the team will be getting ready to mate the spacecraft to the ASAP (the shelf we are going to ride on) next week. Harold Price, NK6K, will be in Kourou later this week and will load the spacecraft software. The spacecraft will sit in trickle charge with the spacecraft computer running the kernel and the command software through launch. Things look good and the whole team is in good spirits. The AMSAT-LU representative, Jose Machao, LU7JCN, and DOVE-BRAMSAT is represented by Junior De Castro, PY2BJO. Quite a bit of work will be done this week on last minute calibration of telemetry channels and training on the command software will be held for AMSAT-LU and BRAMSAT.✦

WHAT ARE THESE G8BPQ NODES?

by Bob Nielsen, W6SWE

Certainly we've all heard of NET/ROM, and most of us are aware of the TheNet controversy (no, I'm not going to get into that here!), many of us have connected to a KA-node, and some have even had the privilege of working through a TexNet node or a ROSE switch. Several months ago, however, a new type of NET/ROM compatible node showed up on the Mheard lists locally and elsewhere. The User command gave a response saying that the node was the "G8BPQ Network System". Being naturally inquisitive, I set about to find out more.

What I found was that the G8BPQ switch, written by John Wiseman, G8BPQ, of Nottingham, England, is a multi-port NET/ROM-compatible node in software which runs on an IBM PC or compatible. After asking around a bit, I was eventually able to find a copy of the software. Reading the documentation, I discovered that in addition to performing as a node, this program would perform the functions of MBBIOS or COMBIOS when used with WORLI or WA7MBL BBS software. At the time, Glenn, WB7TLS, was operating both a BBS and a node (TUS5) a few miles away, using two TNC's and two radios on 145.05 MHz. This sounded like a natural for him, as it would free up one radio and one TNC. He's now been running the G8BPQ software for over six months with the WORLI BBS software and it's been working quite successfully.

Ah, but that's not the end of the story. Mykle, N7JZT, started collecting the observations and comments of many of the local hams regarding the operation of the G8BPQ nodes (by now there are several in the Tucson area) and had sent a lengthy letter containing suggestions and a "wish list" to John Wiseman. After he mentioned this to me, I told him that since I was planning a vacation trip to Great Britain, it wouldn't be difficult at all for me to contact John while I was there.

I spent several hours on the evening of October 11 visiting with John at his home in Mapperly, a neighborhood in the northern part of Nottingham. John works for the British rail system and writes software for their communications network. He started working on his switch program about two years ago and made the first public release in December, 1988. The programming was done in 8086 assembler. The software is still somewhat dynamic and there have been a number of revisions, the latest (at the time of this writing) being version 3.51. This current version supports KISS mode TNC's, as well as Pac-Comm, DRSI and RLC100 multi-port cards. (The RLC100 is a four port card by G8TIC.) John has several enhancements currently in work, including a remote SYSOP capability. In addition to WA7MBL and WORLI, the G8BPQ switch is compatible with AA4RE, G8UFQ and G4YFB BBS software. The interface for the AA4RE and G8UFQ multiconnect software is by an emulation of PK-232 host mode. An applications interface is provided, allowing other software to be attached to the switch. A basic communications terminal program is included in the package. The documentation, which John is continuing to expand, is quite extensive, but is spread over several files.

At the time of my visit, there were approximately 70 stations in the UK running the G8BPQ package, out of a total of 110 nodes. Almost all were in conjunction with a BBS. Most were running two or three channels. A large amount of the packet activity is on the 70 cm. and 23 cm. bands. John said that there was some use of the G3RUH 9600 baud modems taking place. (August, KE0WZ, has set up a bare-bones PC clone as a two-port node on Mount Lemmon here in the Tucson area, using a DRSI card with a 145.01 port and a 9600 baud external modem on 220 MHz as a test port for a planned backbone system for the southwest. This has worked quite well for linking in tests to date.)

The G8BPQ software package is available on CompuServe and several Ham oriented telephone BBS's as well as from TAPR.✦

MODEMS - WHICH ONE IS BEST? A Test Report

by Lyle Johnson, WA7GXD

People often ask me which TNC they should buy. As we discuss the issue, the question always seems to come up, "Which modem is best?" Like the question of which TNC to buy, there is no simple answer.

Are filter-based modems the best? Phase locked loops? Does I.F. filtering make a difference? Is any technology clearly superior to the others?

About three years ago, Eric Gustafson, N7CL, did a side-by-side comparison of TNC's by monitoring off-the-air HF packet activity. These tests revealed a number of interesting results. Check *PACKET RADIO MAGAZINE* for DECEMBER 1986 and JANUARY/FEBRUARY 1987 for a full report.

With various ads claiming superior performance, ease-of-use, bells, whistles and features, I decided it was time someone put the various technologies side-by-side in a laboratory environment and attempted to measure performance. Like productivity, however, performance is a difficult thing to measure. Some qualities, like sensitivity, are easy to determine — but does sensitivity have much to do with actual on-the-air results?

I decided to run several sets of tests. After thinking about digital operation, I came up with this list of initial tests to run.

- Modem sensitivity on both VHF FM and HF "SSB" (FSK).

- Ability to decode when one of the two modem tones is attenuated.
- Tuning tolerance of the demodulator.
- Ease of tuning HF packet.
- Finally, narrow-band modes (like Baudot RTTY) should also be checked for the multimode units.

As you read the rest of this report, bear in mind that a number of things have not been checked in this series of tests. These include the ability to perform under multipath conditions, ability to perform in the presence of nearby signals (QRM), and ability to perform with rapid fading and flutter.

EQUIPMENT

I used the following equipment to run the tests.

- IFR FM/AM1200S signal generator with spectrum analyzer.
- 1 Meter length of RG-58C/U coaxial cable with dual-crimp BNC connectors at each end.
- Mini Circuits CAT30 30 dB attenuator at the radio end of the BNC cable to assure a good match.
- Kenwood TS-440S with optional 1.8 kHz and 500 Hz I.F. filters and PS-430 power supply.
- Tektronix 2230 Digital Storage Oscilloscope.
- Special cabling to match various TNC's to the IFR signal generator.
- Heath HD-4040 TNC with TNC 1 Upgrade installed.

I tested the following TNC's and multi-mode units.

- AEA PK-232 s/n 28330 with 30.DEC.88 firmware.
- Kantronics KPC-2400 s/n 57290 with V2.85 firmware.
- PacComm Micro-2 TNC s/n 0574 PCBoard Rev 1.4 with 1.1.6 firmware.
- MFJ-1278 Rev 6 PC Board w/mods to Rev 8 and 2.3 firmware.
- AIWA APX-M25 s/n 80121155 with 1.1.3M firmware.
- Kantronics UTU-XT/P s/n 60463 with V2.02 firmware. Note that the HF modem of the KAM is essentially the same as the UTU-XT with the exception that the UTU-XT uses a conducting diode for AGC operation while the KAM uses a FET. The KAM input circuit probably has somewhat less distortion as a result.

TESTING METHODS

Having defined the goals of the tests, let's look at the test methods I employed. Some of you reading this report may have suggestions to clarify areas I may have overlooked.

1200 bps AFSK (FM) testing:

I set the HD-4040 to beacon every 10 seconds. The total packet length sent, including flags, FCS, and protocol overhead was just over 1000 bits.

The various TNC's tested on 1200 bps AFSK (FM) were set up to determine the signal level at which reception became less than 100%. A number of RF signal levels in 2 dBm steps were used, and a minimum of five (5) packets were sent at each level. Audio levels were varied to determine the approximate dynamic range of each unit and to ensure sensitivity testing occurred at about the best level for each unit tested. Since I used the speaker output of the TS-440S, I tried reception with and without the speaker attached to determine if it made any discernible difference in the ability of the TNC to demodulate the received signal. (I realize the speaker output may not be the best place to tap received audio, but I wanted the tests to reflect the typical amateur packet installation, not a specially configured one which few people would go to the trouble to set up.)

FM testing was done with a signal whose pre-emphasis was 6 dB/octave (3 kHz at 2200 Hz, 1.7 kHz at 1200 Hz). A second test was conducted with gross overdeviation (more than 6 kHz, equal deviation for each tone) to simulate the signals transmitted by many stations.

The object of the FM testing was to determine:

- the threshold sensitivity of the system
- the ability to operate open-squelch
- the ability to demodulate an over-deviated signal
- the relative performance of various modem implementations under these circumstances.

Things NOT tested include:

- DCD attack time
- DCD hold time
- capture effect in the presence of other signals
- ability to perform in the presence of multipath.

1200 bps AFSK (SSB) testing:

The purposes of the tests in this section had a number of goals:

- overall modem sensitivity
- tuning indicator accuracy and ease-of-use
- ability to tolerate mistuning
- a single-tone test performed to determine if any of the modems could operate on only one tone
- susceptibility to multi-path.

I ran the TS-440S in FSK mode using the 2.2 kHz filter, then repeated the test using the 1.8 kHz filter. Several frames were sent and the number of frames received versus the number sent at each signal level tested was tabulated. Tuning indicator accuracy was measured by tuning in the 1000-bit beacon, then comparing the dial setting of the receiver with the measured (known) correct setting of the receiver.

I simulated single-tone reception using the 500 Hz I.F. filter. I tried to emulate a multi-path fade by using the 2.2 kHz I.F. filter and sweeping the TS-440S audio notch filter once across the passband.

300 bps/1000 Hz shift AFSK (SSB) testing:

I ran this test to use for comparison with 200 Hz shift operation regarding sensitivity and tuning error tolerance. 2.2 kHz and 1.8 kHz I.F. filters were used.

300 bps/200 Hz shift AFSK (SSB) testing:

These tests were run with 2.2. kHz and 500 Hz I.F. filters. Sensitivity, tuning indicator accuracy and ease-of-use, and tuning offset tolerance were tested.

45 bps/200 Hz shift and 100 bps/200 Hz shift AFSK (SSB) 5-level Baudot testing:

This testing was done specifically to evaluate the multi-mode controllers. I checked sensitivity, tuning indicator accuracy and ease-of-use, and tuning error tolerance. I used the UTU-XT to generate the audio tones for testing the AEA and MFJ units. I used the PK-

232 to generate the tones used to check the UTU. Wide and narrow I.F. filters in the TS-440S were used.

TEST RESULTS

1200BPS AFSK/FM

Units tested: PK-232, KPC-2400, Micro-2, MFJ-1278.

NOTE: At an input level of -86 dBm indicated on the signal generator, there was an occasional popping noise from the FM receiver, indicating this was the threshold sensitivity of this receiver. This corresponds to a signal of -116 dBm at the receiver, or 0.35 uV.

PK-232

The PK-232 uses an op-amp filter-based demodulator. The DCD circuit was useless on FM, requiring the radio to be squelched to avoid DCD falsing. Adding a TAPR DCD State Machine upgrade made the DCD functional under open-squelch conditions.

These results were consistent with an audio level from 40 mV p-p through 6 V p-p. I didn't test stronger signals than this. I tested this with and without a speaker attached to the radio at the levels where only a fraction of the packets were being copied. There was no measurable difference in performance.

Micro-2

The Micro-2 uses a TI 3105 demodulator. Like the PK-232, its DCD circuit doesn't work open-squelch. I added a TAPR DCD State Machine, after which the unit performed well without squelch.

The Micro-2 worked well over all audio input levels tested (40 mV p-p through 6 V p-p). An audio level near 200 mV p-p worked best with the over-deviated signal, and performance dropped to about 50% of best when the audio level exceeded 1 volt p-p.

KPC-2400

The KPC-2400 uses the AMD 7910 "World Chip" FSK modem. It worked fine over the 40 mV through 6V p-p audio range, and accepted over-deviated signals without a drop in performance. In fact, it seemed to prefer them!

MFJ-1278

The MFJ-1278 is based on the venerable XR2211 demodulator. This is a phase-locked-loop (PLL) unit used in all TAPR TNC designs to date. It seemed immune to input level changes, but doesn't like overdeviated signals much.

Comments

Audio levels aren't particularly critical with any of the units.

With an overdeviated signal, the AMD7910 (KPC-2400) is best. The PK-232 is a close second and the other units aren't far behind.

1200 BPS AFSK/SSB

The "dBm" levels are relative rather than absolute since the signal generator is calibrated in terms of an FM (or AM) carrier and I was using the sideband energy only.

PK-232

There was no significant difference between the 2.2 kHz and 1.8 kHz I.F. filters. The tuning indicator was 60 Hz off and (in my experience) very difficult to use for tuning.

Micro-2

This unit has no tuning indicator.

KPC-2400

This unit has no tuning indicator.

MFJ-1278

The tuning indicator was very sharp and easy to tune within 30 Hz.

Comments

No unit could handle a single tone only. The MFJ was easily tuned to its area of best performance. The AEA was difficult to tune accurately and the least tolerant of mistuning.

1200 bps AFSK/FM

Number of packets received out of 10 sent.
Pre = Pre-Emphasized. Over = Overdeviated.

	PK-232		Micro-2		KPC-2400		MFJ-1278	
dBm	Pre.	Over.	Pre.	Over.	Pre.	Over.	Pre.	Over.
-86	5	1	5	1	4	10	4	0
-84	10	9	9	5	8	10	10	1
-82	10	10	10	5	10	10	10	9
-80	10	10	10	5	10	10	10	10
-78	-	-	10	10	-	-	-	-

1200 bps AFSK/SSB

Number of packets received out of 5 sent.

dBm	PK-232	Micro-2	KPC	MFJ
-84	0	0	0	0
-82	3	2	0	0
-80	4	4	1	1
-78	5	5	3	3
-76	-	-	4	4
-74	-	-	5	5

Tuning Error Tolerance at -74 dBm.

Number of packets received out of 5 sent.

Hz	PK-232	Micro-2	KPC	MFJ
-250				0
-240	0			
-220				3
-210	2			
-200			0	4
-180	3		4	
-150	2	0	5	5
-120		2		
-100		5	5	5
-90	4			
-60	5			
-50		5	5	5
+50		5	5	5
+100		5	5	5
+120	5	1		
+150	2	0	2	2
+180	2		0	
+200				0
+210	3			
+240	1			

300 bps/1000 Hz shift

This test was run with the units above, less the Micro-2 and plus the Kantronics UTU/XT which has the same modem as the KAM (except the AGC circuit which is slightly different in the KAM).

General

AEA is most tolerant of tuning errors and least able to tune precisely.

AEA and MFJ were most sensitive with solid copy at -80, then UTU at -78, then KPC at -76 for solid copy. Thus the spread from best to worst for solid copy is only 4 dB. AEA had better performance at partial copy by 2 dB over MFJ.

Comments

MFJ very sharp and accurate tuning indicator, about 50 Hz per dot. Got within 30 Hz every time. +350 Hz and -300 Hz came up to 5/5 when signal level increased by +10 dB.

AEA tuning indicator resulted in approx 70 Hz error. Only once got it to

300 bps / 1000 Hz Shift

Number of packets received out of 5 sent.

	PK-232		Micro-2		KPC-2400		MFJ-1278	
dBm	2.2K	1.8K	2.2K	1.8K	2.2K	1.8K	2.2K	1.8K
-86	0	0	0	0	0	0	0	0
-84	1	0	0	0	0	0	0	0
-82	3	2	0	0	0	0	0	0
-80	5	5	1	1	3	1	5	5
-78	5	5	5	5	4	4	5	5
-76	5	5	5	5	5	4	5	5
-74	5	5	5	5	5	5	5	5

Frequency Error Performance at -76 dBm.

Number of packets received out of 5 sent.

	PK-232		Micro-2		KPC2400		MFJ-1278	
Hz								
-400	0	0	0	0	0	0	0	0
-350	4	4	0	0	0	0	0	0
-300	5	5	0	0	1	1	4	5
-200	5	5	0	0	5	5	5	5
-100	5	5	3	0	5	5	5	5
+100	5	5	3	3	5	5	5	5
+200	5	5	1	1	5	5	4	4
+300	5	5	0	0	1	1	0	3
+350	4	4	0	0	0	0	0	0
+400	0	0	0	0	0	0	0	0

50 Hz. The whole bar lights up nearly equally bright.

UTU-XT had good tuning indicator action, repeatably got within 40 Hz.

KPC-2400 using CAL-R and other station sending zeroes had 140 Hz tuning error.

DCD was OK on all units when working against a quiet background. When things got noisy, DCD setting was less forgiving on AEA. With DCD State machine, DCD action was solid and reliable on AEA and KPC. UTU-XT was useable, MFJ was solid and reliable.

300 bps/200 Hz Shift

This test was run with the units above plus the AIWA APX-M25, an AMD7911-based unit with a simple tuning indicator.

Comments

UTU tuning indicator consistently tuned within 10 Hz, easy to use. MFJ tuning indicator consistently within 10 Hz, easy to use. KPC "CAL R" tuning system within 20 Hz, cumbersome to

300 bps / 200 Hz Shift

Number of packets received out of 5 sent.

	PK-232		UTU-XT		KPC-2400		KPC-2400		MFJ-1278		APX-M25	
Tones:	2110/2310		1600/1800		1650/1850		2025/2225		2110/2310		2025/2225	
dBm	2.2K	.5K	2.2K	.5K	2.2K	.5K	2.2K	.5K	2.2K	.5K	2.2K	.5K
-88	1	2	0	0	0	0	0	0	0	0	0	0
-86	4	5	1	2	0	0	0	0	1	2	0	1
-84	5	5	4	5	0	0	0	0	3	4	0	3
-82	5	5	5	5	0	0	0	0	3	5	0	5
-80	5	5	5	5	0	4	0	2	5	5	5	5
-78	5	5	5	5	5	5	5	5	5	5	5	5

Frequency Error Performance at -76 dBm.

Number of packets received out of 5 sent.

	PK-232		UTU-XT		KPC-2400		KPC-2400		MFJ-1278		APX-M25	
Hz												
-100	0	0	0	0	0	0	0	0	0	0	0	0
-80	0	0	0	0	0	0	0	0	0	0	0	0
-70	0	0	0	0	0	0	0	0	0	0	0	0
-60	0	0	0	0	0	0	2	4	0	0	4	5
-50	2	0	0	0	0	0	4	5	0	0	5	5
-40	3	3	1	0	4	0	3	5	2	0	5	5
-30	3	5	5	4	5	4	5	5	5	4	5	5
-20	5	5	5	5	5	5	5	5	5	5	5	5
+20	5	5	5	5	5	5	5	5	5	5	5	5
+30	4	5	5	5	4	4	5	5	5	5	5	5
+40	4	4	5	5	4	4	5	5	5	5	5	5
+50	4	0	5	3	0	2	0	0	1	0	0	3
+60	0	0	5	0	0	0	0	0	0	0	0	0
+70	0	0	0	0	0	0	0	0	0	0	0	0
+80	0	0	0	0	0	0	0	0	0	0	0	0
+100	0	0	0	0	0	0	0	0	0	0	0	0

use. AIWA tuning indicator consistently within 30 Hz, usually 10 or 20 Hz, simple to use. AEA usually 30 Hz off, sometimes 20 Hz, not hard to use but hardest of the lot (except the KPC-2400 which isn't really a tuning indicator).

Sharp IF filter generally helped at weak signal levels, but a penalty if unit not tuned in correctly to frequency. A sharp IF filter is probably needed for QRM protection.

PK-232 and UTU (filter based modems) were the most sensitive by a couple of dB, with the MFJ (PLL) next and the single chip 7910 last. It is interesting to note that the AIWA and KPC use the same chip design, yet have 4 to 6 dB sensitivity differences.

All units copy pretty well up to 30 Hz off and are dead by 60 Hz off.

45 BPS and 100 BPS 200 Hz Shift

Testing done with UTUXT, PK-232 and MFJ-1278. UTU sent tones to PK-232 and MFJ; PK-232 sent tones to UTU. PK-232 tones were -2dB lower than signal generator output amplitude, so the signal generator dial was set 2 dB higher when testing the UTU.

PK-232 and UTU made no difference with IF filter, so testing was done with the wide IF filter. MFJ noticed the narrow filter, so testing was done with narrow IF filter for it.

For reference -70 dial is actually -125 dBm, or about 0.13 uV at the TS-440S antenna.

The table lists the number of errors in decoding the 250 character test message. The MFJ table has entries for wide and narrow IF filters.

NOTE: MFJ errors given at -70 normalized level rather than -66, for equivalent dB above threshold.

All units could tune within 20 Hz most of the time, and 30 Hz worst case. The MFJ and UTU were easier to tune than the PK-232. All tuning indicators did better with a good S/N than a marginal one.

PK-232 and UTU demonstrate almost exactly the same sensitivity and error rates. The UTU is radically more tolerant to frequency offsets than the others. The MFJ fared the worst. Note that increased signal strength at 70 Hz offset helped a bit, but at -100 Hz the PK-232 and MFJ were useless.

CAVEATS, WEASEL-WORDS AND WARNINGS

These test results are NOT the final word. The characteristics measured may not have a strong bearing on actual on-the-air performance. They are simply an attempt to measure the things that are measurable in a modest lab. More testing is planned for 1990 using wideband, recorded off-the-air signals to see how the various units stack up.

Don't use these results to decide which unit to buy apart from a number of other factors. Physical size, power drain, computer software support, price, update policies, user interface and a number of other important parameters are simply not covered here.

I would like to see others run this or a similar battery of tests to see if these results are duplicable.✦

45 bps and 100 bps / 200 Hz Shift

Number of errors in decoding 250 character test message.

	PK-232		UTU-XT		MFJ-Wide		MFJ-Narrow	
dBm	45	100	45	100	45	100	45	100
-80	-	-	-	-	-	-	-	-
-78	-	-	26	-	-	-	-	-
-76	30	30	3	-	-	-	-	-
-74	1	3	0	22	-	-	-	-
-72	0	0	0	0	-	30	25	14
-70	0	0	0	0	40	6	1	0
-68	0	0	0	0	17	0	0	0
-66	0	0	0	0	0	0	0	0

Frequency Error Performance.

	PK-232		UTU-XT		MFJ-Wide		MFJ-Narrow	
Hz								
-150	-	-	-	-	-	-	-	-
-120	-	-	0	-	-	-	-	-
-100	-	-	0	-	-	-	-	-
-70	15	-	0	35	-	-	24	-
-50	1	0	0	0	-	3	2	4
-30	0	0	0	0	-	0	0	0
+30	0	0	0	0	-	10	0	0
+50	0	3	0	6	-	-	1	0
+70	15	-	0	2	-	-	-	-
+100	-	-	0	40	-	-	-	-
+120	-	-	6	-	-	-	-	-
+150	-	-	-	-	-	-	-	-

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