SANDPAC News

San Diego Packet Radio Association Newsletter

Volume 92, No. 1 - April, 1992 Editor: Paul Williamson, KB5MU

What's Inside

The President's Packet

Welcome to the SANDPAC Newsletter, the first since I've been associated with the association. There seems to have been a lull in packet interest in recent years, but I think there are interesting times upon us again.

Several years ago it took someone with an engineering degree and lots of test equipment to get a packet station on the air. It was a major accomplishment to go keyboard to keyboard across town at 1200 Baud. As the commercial equipment manufacturers got tuned into packet radio it has become easier and easier to just plug and play. About the most difficult thing today is to solder a microphone connector on the end of the cable that comes with the TNC. With the proliferation of BBS's, mail drops and other such on-air services, you don't even have to wait for someone else to be on the air to have fun with packet.

All this sounds good for the guys who would rather pound the keyboard than burn their fingers on a soldering iron, but what's in store for the hard core techies among us? There have never been more opportunities available for neat things to work on. 9600 Baud modems are inexpensive and easy to come by in a few different forms. 56 Kilobit modems are another high speed challenge. Of course there are those who don't know when

to quit and are trying to build 1 Megabit plus modems.

Systems like the Metro Net and worm holes are cropping up to make life easier for the operators trying to make long distance contacts, and to take the load off the local channels to leave room for more contacts. Satellite gateways are starting to be a reality. The flock of low earth orbit digital satellites currently in orbit are soon to be joined by others to provide more packet capacity in the sky.

Packet infrastructure like this doesn't just fall out of the sky, except when ESA has a launch vehicle failure. We have to pitch in and do our part. Participating in SANDPAC is one way of contributing. Now I don't mean that you have to show up at every meeting and wear your SANDPAC name badge to every amateur radio function. Some people make tremendous contributions and only show up once a year (if we are lucky) to show off the latest triumph. The point is, SANDPAC is a very loose association of people with a common goal of enjoying many facets of packet radio.

Also there are other organizations that are part of the puzzle. AMSAT is the group that puts up the satellites and the ham radio aboard the space shuttle called SAREX. They are working on gathering enough money together to launch the Phase IIID monster satellite called Falcon. It should make satellite access even easier and reduce earth station requirements. TAPR is the name behind the TNC and modem kits we have all come to depend on. One of their latest projects is a low cost deviation meter to allow amateurs to adjust their packet stations for proper operation accurately and simply. SANDPAC intends to acquire one as soon as they are available for the use of the members and to allow us to put on packet workshops where we can send the visitors home with a TNC set up properly for their radio.

There is one opportunity coming up that has me all excited, but it's going to take a lot more organization and public exposure than we are used to. In September the San Diego Computer Society and the ComputorEdge Magazine are putting on a computer fair. Since packet radio is just as much about computers as it is about radio, I think this is the time to let our light shine out from under that bushel basket we usually keep over it. There are a lot of people out there who could become important contributors to our packet hobby if they only knew more about it. Check out the proposal elsewhere in this issue and think about how you could help.

Roy Davis -- WB9RKN

SANDPAC Calendar

SANDPAC Meeting The San Diego Packet Radio Association meets monthly on the second Tuesday at 7:30 PM at the Kearny Mesa Recreation Center on Armstrong at Mesa College Drive.

Packet Brunch Packet people in San Diego get together for an informal brunch each month on the first Saturday at 10:00 AM at Mr. G's Restaurant on Clairemont Mesa Blvd.

Packet Voice Net The Palomar ARC sponsors a voice net for packet radio on Tuesday evenings (except the second Tuesday) at 9:00 PM on the Palomar repeater, 146.73 MHz (-). If you have questions (or answers!) about packet radio, please check in to the net.

News & Notes

This issue of the SANDPAC Newsletter is going out to the whole mailing list of interested parties, even those not currently members of SANDPAC. If you're not a member, please see the next item. The next issue may go out only to members. It's been three years since the last newsletter, but it should only be a month or two until the next.

Renew your membership! SANDPAC dues are $16 per year. They cover SANDPAC projects and the newsletter when we manage to print one. Send them to SANDPAC's business address:

SANDPAC
c/o Barry Gershenfeld, WA2QMI
5085 Arroyo Lindo Ave.
San Diego, CA 92117

Newsletter Material Needed Since the entire Blow by Blow Account didn't fit in this issue of the SANDPAC Newsletter, there will be another issue coming out in a month or two. This might even be the beginning of a regular publishing schedule. So, if you know of some news that's fit to print, please forward it to Paul Williamson, KB5MU. Electronic submissions preferred. As Franklin used to say, we'll print almost anything.

PALMAR Node Status The Palomar ARC NET/ROM node on Mt. Palomar, W6NWG-1, will soon be upgraded to include a 9600 baud link to the San Diego Metro Net. The Metro net links high-level sites throughout the county. As of this writing, all that's missing is the antenna.

OTAY Node Status The SANDRA node on Mt. Otay will soon undergo a major upgrade to include 1200 baud and 9600 baud full duplex user access on 145.36 (-), 56000 baud user access on 433.05 MHz, a 9600 baud Metro Net link, and a 4800 baud 6m link. The node switch for this upgrade, a Gracilis PackeTen, was funded by SANDPAC. The equipment is currently running in a test configuration at the home of Brian Kantor, WB6CYT, who has done most of the work of putting it together.

ESCN Node Status Marvin Munster, WB6PKK, recently revamped the Escondido ARS node. It's now called ESCN:WB6PKK-8, and it runs TheNet firmware. Look for further info on ESCN in a future issue of this newsletter.

WB6CYT-2 BBS Brian has also been running a bulletin board system on a test basis on the duplex pair, 145.36 MHz (-). The BBS is connected to the network via the WB6YMH BBS, so it carries the full set of bulletins and can forward messages into the network. There are also some interesting files online, like the entire FCC Part 97 rules. Give it a try.

Satellites More and more people locally are getting equipped for packet radio satellite operation on AMSAT OSCAR 16, LUSAT OSCAR 19, and UOSAT OSCAR 22. Satellites are a common topic of discussion at the meetings and on the voice net. DOVE OSCAR 17 is still transmitting packet telemetry on 145.825 MHz, and is easy to receive with any standard packet radio station.

Field Day is coming up the last full weekend of June. In recent years, the rules have allowed one 'free' packet station and a 100 point bonus for making at least one packet contact. Check the Field Day announcement in the May issue of QST for this year's rules, and get your Field Day station on packet this year.

Packet BattleShip Steven Ruiz, KC6MDV, has come up with a novel application for packet radio. His program, *Packet BattleShip 1.3*, allows two packet users to play the classic game *Battleship* over the radio. The players can also type messages back and forth to each other during the game. You can download PKTBAT.ZIP from the RadioSport! BBS (279-3921), or check your favorite packet BBS.

HF STA Extended The FCC has granted a "final extension" of the Special Temporary Authority (STA) for unattended HF digital operator by a specified group of amateur stations through January 3, 1993. If no permanent rules change is made in the meantime, all unattended HF forwarding in the US will have to stop. (via *Gateway*)

National Traffic System A recent issue of the *ARRL Field Forum* featured a presentation of the latest Terms of Reference (TOR) document for the National Traffic System. The new TOR includes the office of Digital Coordinator, and roles for BBS systems at the local, section, and interregional levels of NTS. The new TOR acknowledges the increasingly important role packet systems have been playing in traffic handling. (via *Gateway*)

Operating Guidelines Region 3 of the International Amateur Radio Union (IARU), the Japan Amateur Radio League (JARL), and the Radio Society of Great Britain (RSGB) have each adopted a set of guidelines

for packet radio operators. These guidelines range from simple admonitions to operate in accordance with government regulations to more subjective criteria for what constitutes appropriate subject matter. (via *Gateway*)

10m Packet Beacon Listen for GB3PKT, the first 10m packet radio beacon in the UK, on 28.196 MHz. It transmits every 60 seconds with 25 ERP from Point Clear in Essex. Send reception reports via packet mail to G0MBA @ GB7DNS.#31.GBR.EU. (via *Gateway*)

Thanks to Sybil Allbright, W6GIC, for printing mailing labels for this issue of the newsletter on short notice.

A Blow-By-Blow Account of the 1992 TAPR Annual Meeting

[Due to the great length of the Blow by Blow Account this year, only about half of it appears in this issue. The other half will appear in a later issue of the SANDPAC Newsletter. -Ed.]

The following is based on the notes I took during the TAPR annual meeting. Any mistakes are mine. On no account should you assume that this account represents the official position of TAPR or anybody else. But I hope you find it interesting. You may republish parts or all of this document if you wish, but if you do please credit the SANDPAC Newsletter. Sorry it took so long for me to get these notes published this time.

73 -Paul Williamson, KB5MU

The 1992 TAPR Annual Meeting was called to order by TAPR President Bob Nielsen, W6SWE, on March 7 at 9:41AM at the Inn At the Airport in scenic Tucson. He introduced Master of Ceremonies "Packet" Pete Eaton, WB9FLW, who introduced TAPR Office Manager Heather Johnson, N7DZU.

Heather welcomed everybody to Tucson. TAPR office hours are Tuesday to Friday, 10 AM to 3 PM. Thanks to Bob Nielsen, W6SWE, for his work as President of TAPR. Thanks to Pete Eaton, WB9FLW, for taking care of TAPR's presence at the Dayton Hamvention. Thanks to Ron Bates, AG7H, for fielding technical questions. Thanks to Dave Medley, KI6QE, for fielding questions on the PK-232 DCD mod and the PSK modem. Everybody hates not to have the latest version of software, so thanks to the new librarian, Lou Nigro, KW7H, for updating all the software in the TAPR library. Anybody who has software that should be in the TAPR library, contact Lou. And of course, thanks to Lyle Johnson, WA7GXD, for fielding the daily barrage of miscellaneous questions. The new TAPR 9600 baud modem is available now at $70, and the Trakbox is available now at $185. Thanks to everybody associated with TAPR for being fun to work with.

Bob Nielsen, W6SWE, took the microphone again, and asked everybody to introduce themselves. 112 of the usual suspects from all over the place were present. Nielsen then announced that the TAPR Board of Directors had been resized to 9 positions. The new officers are:

President:	Bob Nielsen, W6SWE
Vice President:	Dave Toth, VE3GYQ
Secretary:	(open, volunteers?)
Directors:	Tom Clark, W3IWI
	Jerry Crawford, K7UPJ
	Jack Davis, WA4EJR
	Pete Eaton, WB9FLW
	Greg Jones, WD5IVD
	Dan Morrison, KV7B
	Harold Price, NK6K

Bob Hansen, N2GDE, will continue to serve as editor of the Packet Status Register. Lou Nigro, KW7H, will take over as software librarian.

Pete Eaton, WB9FLW, took the microphone at 10:00 AM. For the first time, this year's TAPR meeting is recorded by a printed Proceedings. Thanks to the several speakers who managed to submit papers for the Proceedings. He then introduced the first speaker:

Lyle Johnson, WA7GXD
TAPR's New 9600 Baud Modem – What It Is, What It Isn't

TAPR's new 9600 baud modem is compatible with existing K9NG and G3RUH 9600 baud modems. It's an inexpensive kit, capable of

full duplex operation (like the G3RUH but unlike the K9NG), with improved DCD (data carrier detect) performance and clock recovery. It looks up the transmit waveform in ROM, like the G3RUH, and has a frequency response compensation adjustment on the receive side. The board is designed to mount internally in a TNC-2 (where it's a tight squeeze) or a PK-232. The board includes provisions for bit regeneration (parts optional) for use in a full duplex digipeater.

There are about 5000 G3RUH modems in service overall. Heathkit is mostly out of the kit business, so one of the goals of the 9600 baud modem project was to leverage TAPR's expertise at packaging kits to make available a 9600 baud modem with better performance than the K9NG at a reasonable price. The design address problems with the K9NG modem (like its half duplex design) and adds features for network builders (like the bit regenerator). The state machine in the K9NG could mistake silence (like a squelched radio or a weak carrier) for a data carrier, thus holding off transmission indefinitely. The new state machine design cures that problem, and also gives better clock recovery.

A block diagram of the modulator portion of the modem was displayed. The modem disconnect header (TAPR standard or PacComm extended) goes into a data scrambler, to the transmit waveform ROM lookup table, to a digital to analog converter, through a filter, and out to the radio. The clock can be obtained from the modem disconnect, or generated on the 9600 baud modem board. RTS from the TNC controls PTT through a watchdog and an LED indicator. Programmable logic provides switching from the 9600 baud modem to the TNC's internal modem. It is still necessary to hook up the modem directly to the discriminator and modulator inside the radio, not to the speaker and microphone jacks.

A block diagram of the demodulator portion of the 9600 baud modem was displayed. The input buffer has a high input impedance, 100 kohm or more. A Butterworth 6 kHz filter is tweakable to compensate for the frequency response of the receiver, which is especially useful with rigs with LC filters like Mitreks. The data slicer feeds a descrambler, state machine and DCD circuit, with an output for a bit error rate test. The DCD detects synchronous transitions, rather than the lack of asynchronous transitions as before.

Block diagram of the bit regenerator. It consists of a PAL and a FIFO chip. The FIFO inserts a nominal delay of 8 bits, and is required to eliminate bit jitter and timing errors in the received signal. The result is that if the repeater can copy the input signal at all, it will transmit a perfect signal. A diagram of the switching configuration shows how the bit regen is connected with the TNC, so that the TNC can transmit on the channel instead of the bit regenerator.

A sample of the 9600 baud modem was passed around the room. It's a four layer PC board, which helps cut the RF noise. It's relatively compact, but it has a lot of parts on it. The documentation shipping today is preliminary, and needs more information on hookup to various TNCs and radios. Updated documentation will be sent to early buyers.

Question: I'm interested in higher speeds than 9600. Is this modem planned to be scalable to higher baud rates?
Answer: It hasn't been tested, but it should work. The op amps and the ROM lookups are plenty fast. The input analog filter would have to be adjusted. The transmit lookup table might help at higher speeds to compensate for the nonlinearities of a wider filter. We should try that experiment.

Question: Has it been tested on the satellite? How does its performance compare to the G3RUH?
Answer: It hasn't been tested on the satellite yet. Lab bench tests aren't realistic, but they show that the new modem is no better than the G3RUH, and 1 to 2 dB worse under some conditions.

Question: The PK-232 limits the TBAUD (computer to TNC) rate to 9600. Does this cause a problem when using the PK-232 with a 9600 baud modem?
Answer: We haven't noticed any problems in testing. Probably the worst thing is that you

won't be able to keep the pipe completely full on transmit, resulting in dead time.

On the PK-232, the ALTMODEM 1 command permits the user to switch to the 9600 baud modem from the keyboard. This means you effectively have a third radio port, because you can leave the PK-232's two existing ports hooked up to other radios.

TXD (delay between PTT and first data) is another issue. If you have the state machine DCD mod kit in your PK-232, there's a small extra delay that requires increased DCD at the other end. With a TNC-2 or a Kantronics DataEngine we could run TXD of 1 or 2.

Question: Has the modem been tried at 4800 baud on the 6m backbone?
Answer: No.

Dewayne Hendricks, WA8DZP
Use of CDMA Spread Spectrum in the Amateur Service

Last year at the TAPR meeting, we talked about Part 15 spread spectrum (SS) communications systems, and displayed a low-cost commercial product capable of high data rates. The year before that, N3FCT presented a paper on license-free spread spectrum. Folks in the San Francisco Bay area were inspired to look at the Part 15 market. The results of a field test of units from Proxim was posted on Usenet. One watt into a 6 dBi antenna gave 2 miles LOS tested and 8 miles LOS predicted at 121 kbps. There's been lots of activity in the wireless LAN market and at the FCC since then. We wanted to find out why the amateur radio service isn't using SS techniques, and approach the FCC for whatever rule changes are needed. An STA (Special Temporary Authority) for testing was sought and obtained.

A second generation Proxim unit was passed around. It is a 121 kbps data radio (data in, antenna out) in a very tiny box. In the OEM package for laptops, it costs $50. The internal modules of the Proxim radio were displayed - all very tiny. Computer manufacturers are starting to put these directly into laptops for wireless LAN use. Challenge to ham radio: get coordinated with the computer BBS folks and build a wireless Internet.

The ARRL Spread Spectrum Handbook is good for a basic tutorial and for historical information on SS. AMRAD did the experiments that led to the current rules permitting SS. The present rules are like handcuffs. In particular, they mean that amateurs won't be able to use commercial SS products, because they don't happen to use one of the few spreading sequences permitted by the rules. We decided to seek a rules change. This turned into a long process. It turns out to be important to use connections in rulemaking matters. After last year's meeting, Paul Rinaldo, W4RI, at ARRL HQ was approached for, and arranged, ARRL cooperation for an STA submission. After several months, and polishing by the League lawyers, the STA application was submitted to the FCC, which promptly sat on it and did nothing.

About this time, the League managed to get FCC Chief Engineer Stanley to speak at the Computer Networking Conference. Stanley is a proponent of spread spectrum, and he was interested in the amateur proposal. He assigned a staffer to the STA. The STA requested a two year authorization for any spreading code on any VHF or higher band. Before the STA could be approved, the staffer had to get every agency involved with the use of any of those bands to accept the proposal. It was a lot of work, but with support for Stanley and the League is was done. The STA was granted.

There are plans for tests in at least the Northern and Southern California areas. People interested in serious experimentation with SS can be added to the STA. The intention is to eventually submit a Petition for rulemaking to get a better set of SS rules. The restrictions on spreading codes and the requirement for narrowband station ID are particularly onerous.

One test is starting in San Diego, under the California State Library project for packet radio. Using radios produced by SRI, the project will interconnect libraries to the wide variety of online databases available via the Internet, without the cost of a 56 kbps landline connection to the Internet. The pilot

project in San Diego is sponsored by Apple Computer, and radios have been donated by Tetherless Access (Hendricks's company) and by hams. Parts of the network are operated under Part 15 (license free), Part 97 (amateur), and Part 5 (experimental).

Funding has been allocated in the Bay area to connect 100 libraries from San Jose to Roseville, San Francisco to Sacramento, all in one WAN. Part 97 (amateur) radios are to be used for long haul links, and Part 15 radios for intra-city links. This experiment will last through the end of the year. Phase II will involve redesigned 1.5 Mbps radios and associated networking software. Currently the project supports only Macintosh computers, partly because any Mac off the shelf can handle up to 900 kbps data links. Hams in northern and southern California will be seeded with equipment to try out Phase II.

There's a lot of work to do. First, get the FCC rules changed. That will take 1 to 1.5 years, on the fast track. It is hoped that the rules will be changed before the STA ends. Then hope that manufacturers will go after the ham market. We haven't done a good job of keeping the FCC up to date. We need to tell the FCC where the public interest lies. The FCC wants to help, but we have to play the game: STAs, Part 15, waivers, and so forth.

Question: Is all the Part 15 activity at 900 MHz?
Answer: No, we're not using 900 MHz at all. We are currently working at 2.4 GHz, and have plans for 5.7 GHz.

Fried Heyn, WA6WZO
ARRL Southwestern Division Director

Read the Division newsletter for more about what's going on. Some high points:
There's a bill in Congress that can protect amateur frequencies from further erosion.
A big effort funded by the ARRL membership was directed to preserving amateur spectrum at WARC-92. The results are not final yet, but it appears that no amateur spectrum was lost at the conference!
The 1992 ARRL National Convention is at the Los Angeles Airport Marriott.

Jon Bloom, KE3Z
TAPR DSP Project Report

KE3Z received one of the first set of beta test DSP boards from the hardware designer, Lyle Johnson. Procrastination set in: the board has over 2000 holes, so assembling it is a bit of work. Finally, got it assembled. The next step was to learn about how to do DSP programming. Highly recommended: the Computer Literacy Bookstores in and around San Jose. Good books for techno-weenies, including some on DSP.

Some preliminary DSP applications are already written and working. A Bell 202 (1200 bps AFSK, like on 2m packet) modem is up and working, with a driver for KA9Q NOS for packet use. A RTTY modem (2125/2295 Hz AFSK) with a RTTY driver and receive-only AMTOR driver is working. Dave Hershberger, W9GR, has written two audio-in/audio-out filter programs. One notches out tone interferers from the audio channel, and works great. The other tries to remove noise from an SSB signal, and needs more work. These filters were originally written for a TMS32010 board of his own design, and have been mechanically ported to the TMS320C20 on the TAPR DSP board (so they aren't optimized for it).

The lesson is that DSP software isn't necessarily magic anymore. It is quite possible to write working modem software, for instance, without getting heavily into sophisticated mathematics. The basic building blocks are simple, and design tools exist to handle filter design.

Coming attractions:
- ? Bell 103 modem (HF packet)
- ? 1200 baud PSK for Pacsats
- ? 9600 baud FSK (K9NG/G3RUH/TAPR compatible)
- ? Spectrum display
- ? 4800 baud PSK for Pacsat - the satellite has never been in this mode, since no user modems have ever been built.
- ? 2400 bps Kantronics-style
- ? improved W9GR "de-noiser" filter
- ? weather fax
- ? slow-scan television

Some of these applications exist for other boards, and just need to be ported to the TAPR board. Others need to be written from scratch. Many of these applications will be implemented over this spring and summer. PC software to support the applications is also needed. NOS is nice for some packet applications, but other applications need other PC software.

A virtual-hardware block diagram of the RTTY demodulator is shown. It's just two bandpass filters running into detectors, followed by a comparator and lowpass filter. Standard stuff.

DSP-oriented block diagram of the RTTY demodulator. The bandpass filters are straight out of a manufacturer's application note. The coefficients for the filters are computed by a computer program, so no heavy math is needed. The filter design is an 80-tap FIR (finite impulse response) linear phase filter. The detector is just absolute value, then a peak detector followed by a decay. The comparator is just a subtraction. The lowpass filter is another cookbook design. That's it. Notice the absence of any higher math in this description. This isn't the optimum demodulator, but it's as good as most analog designs, and it works.

A similar approach was tried for the Bell 202 demodulator, but for unknown reasons it didn't work very well. A Bell 103 modem was taken from another ap note, based on a discriminator design: the audio is delayed by 90 degrees and mixed with itself, then lowpass filtered and compared to zero. The Bell 202 demodulator is just this design, tweaked up for Bell 202 tones and bit rate.

The book *Digital Signal Processing Experiments* by Alan Kamas and Edward A. Lee contains a diskette with educational versions of Burr-Brown DSP design tools, including the tool that generates coefficients for FIR filters. The book is quite inexpensive (about $21) for a DSP tool set. It's published by Prentice-Hall; recommended.

Both DSP programmers and PC programmers are needed to work on applications for the TAPR DSP project. The PC level programmer sees an environment much like a DRSI board plugged into a PC. Contact Jon Bloom if you're interested.

Tom Clark, W3IWI, spoke up:
The TAPR DSP project grew out of earlier development on the Dalanco-Spry Model 10 DSP board. About 30 of these boards were purchased, and probably some could be made available to new interested people. Lots of applications were written for the Dalanco-Spry board, and they're all available for the grabbing on tomcat (Tom C's AT) by anonymous FTP via Internet, or by telephone, or by floppy disk if necessary. Another application that's needed is a good adaptive HF modem (along the lines of Clover II), and HF protocols that can use them. AX.25 sucks on HF. AMTOR has problems, too. Pacsat broadcast protocols are a bit like what's needed for an HF protocol, but it needs changes for the HF environment.

Question: Who is doing satellite imaging?
Answer (W3IWI): The AEA box has it. The Dalanco-Spry board had it, and that version will be ported (or rewritten) for the TAPR DSP board. We may want to rewrite rather than porting Dalanco-Spry applications, because the subset of instructions supported by that processor was pretty brain-damaged compared to the instruction set of the TMS320C20 used on the TAPR DSP. The AEA box contains a Motorola 56001 DSP processor. Its modems are superb compared to analog modems.

Question: What sampling rate can DSPs handle?
Answer (W3IWI): The Dalanco-Spry board could do a spectral display at 50 kHz.
Answer (KE3Z): It's been suggested that we can just digitize the antenna voltage.
Answer (W3IWI): Unintentional radiation can be a problem. The DSP processors can generate a lot of crud.
Answer (KE3Z): The TAPR DSP board is pretty well decoupled.

Bob Nielsen presented an award to Chuck Green, N0ADI, for his outstanding

contributions to the development of packet radio through ten years of TAPR. Chuck accepted the award, but claimed that it represents the teamwork that goes on behind the scenes everywhere.

Pete Eaton held the drawing for door prizes, then the meeting broke for lunch.

Mike Parker, KT7D
The Radio Workstation Concept

Block diagram: Antenna connected to analog radio, connected to a digital sampling and output box, connected to a general purpose workstation.

The problem with DSP software is that it's so difficult to write for special-purpose DSP processors. By the time you've finished writing the software, the special-purpose DSP processor you wrote it for is obsolete. Worse, by that time your general-purpose workstation has improved in performance to the point where it outperforms the old special-purpose DSP! This whole problem can be bypassed by writing the DSP application for the general purpose workstation in the first place. Portable languages can be used, so it should be easy to take advantage of improved workstation technology as it comes along.

Block diagram of a sample application (not implemented): meteorology satellite image reception and display. The software can be written in manageable small modules, like orbit prediction or overlay generation, and the resulting modules can be patched together readily to make a complex application.

The SPARCstation currently used as the workstation costs about $10,000 after discounts. Thus the TAPR DSP project and the Radio Workstation approach address different (but overlapping) issues. The TAPR DSP is cost effective, IF you can get the software working quickly. Experimental applications written for the Radio Workstation might serve as prototypes for DSP-board applications.

The current configuration uses a DAT (digital audio tape) machine interfaced via SCSI to the SPARCstation or VAX, running Unix or VMS, with signal processing software, an interactive display layer like X, and FORTRAN with VMS extensions and C for widgets. This isn't a cheap configuration, but it's off-the-shelf. The code developed for this project is being made available free, on the condition that if you add to it, you make your results available free also.

Why should TAPR get involved in this project?
? to help promote research
? to spend time doing research, not software development
? to develop and debug applications for the TAPR DSP board
? to help develop standards for file structures, datalink structures, and so forth, before it's too late.

Question: How big is the publicly-available source code?
Answer: About 100,000 lines of code, comprising 300 processing primitives.

Tom Clark, W3IWI
Various Topics

Topic #1: 900 MHz

In 1985, Motorola and NEC were engaged in a battle to dominate the market for cellular telephone base station equipment. In 1990, NEC gave up on the market, and the hardware they had managed to sell was orphaned. In 1991, the NEC hardware at cell sites in Richmond was scrapped. A total of over 100 45W radios already outfitted for 19.2 kbps data were made available surplus for $20 each. The equipment complement for a normal cell site was 16 transmitters and 16 receivers, all nicely racked up. Six cell sites plus spares were scrapped. Each cluster weighs about 800 pounds and fills a pickup truck. The salvaged radios are all spoken for, but similar opportunities may become available in other areas.

The radios are set up for 19.2 kbps data, with a digital interface, used originally for signaling for billing purposes. They are

designed for full duplex operation, and the receiver won't work without the transmitter operating. An analysis of the filters indicates that data scramblers will probably not be required. The transmitters are a very simple, conservative design. They are serviceable, understandable, and robust.

Block diagram of the receiver. A buffer amp feeds a synthesizer-driven mixer, followed by a standard IF and discriminator. A measurement of received signal strength goes to a Z80 microprocessor. The audio and demodulated data go out. The 70 MHz IF filters are from the same line as those used in the Microsat receiver. The RF filters will need to be replaced with ones that can go up to the amateur 900 MHz frequencies. High-side injection will be needed, because low-side injection puts the IF image in a crowded spot in the band. The modification involves removing a chip capacitor and trimming a microstrip. It remains to be seen whether the Z80 processor part of the board is useful. Perhaps it could be used for signal strength telemetry.

Block diagram of the transmitter. A 15.36 MHz oscillator drives a synthesizer. A power controlled amplifier chain feeds the antenna. The modulator frequency modulates the synthesizer. One bandpass filter in the RF path needs to be replaced to reach the amateur 900 MHz band.

All this cost us $20 per unit. Be jealous.

Outstanding issues and problems:

? The transmit frequency isn't easily moved. Luckily, this is a relatively simple radio so modifications are easy.

? Frequency stability. In the cell site, the radios were driven by one common master oscillator at 15.36 MHz. To use the radios individually and get 1 KHz error at 900 MHz, we need to provide an oscillator that's good to one part in 1e6. Crystal manufacturers want $80 to $90 for such an oscillator, despite the quantity price of around $7. If anybody knows a source for small quantities of 15.36 MHz oscillators, please let me know.

? Antennas and preamps. To use all 100 radios, we need to get 200 antennas and 100 preamps. They have to be cheap and easy to replicate 100 times.

? The vehicle locator service has priority over the amateur service in the 900 MHz band. The AVL (automatic vehicle locator) folks have been very aggressive about defending their allocation, even threatening civil suits against retail stores using theft alarms in the band. The North Texas Microwave Group is also looking into this problem.

? Network coordination and architecture. This is mainly a political problem. It has practical implications, like what kind of antennas are needed and where they have to be pointed. The biggest problem is how get everyone to agree on something, anything.

? Data pump. The standard NET/ROM or TheNet stack of TNC's isn't suitable. Something like the Kantronics DataEngine, PacComm's V53 board, or the Gracilis PackeTen board is needed. It has to be cheap, reliable, and robust enough to survive a mountaintop environment.

Topic #2: AO-13 orbit decay and Phase III-D

AMSAT OSCAR-13 is in a highly elliptical orbit, and its perigee height has been decreasing steadily. If this trend continues, the satellite would be lost during 1992. However, the perigee height is starting to turn up, as predicted.

A graph shows the prediction generated using the Cray computer running the NASA GEODYN theoretical model of deep space orbits, and the NORAD tracking data obtained since the prediction was run. The real data tracks the prediction pretty well. The prediction shows that AO-13 will be lost in 1996.

The effect is NOT atmospheric drag. The gravity field of the Sun and the Moon are changing the shape of the orbit, making it more narrow and moving it toward apogee. When the eccentricity reaches 0.75, the

perigee will intersect the atmosphere. The inclination is also changing.

AO-13 is going to die. There's no way to save it: there's no fuel on board, and there's no way to dig a deep enough tunnel through the Earth. So, what we need is a replacement satellite.

A diagram of the Phase III-D mechanical design shows a *really big* satellite. It's roughly triangular, 8 feet on a side, with two solar panel "wings" with a 17-foot span. The configuration shown (one of several proposed) has antennas for bands from 10 meters to 10 GHz. The satellite will have receivers on 2 meters through 3 cm, transmitters on 10 meters through 3 cm, and a programmable IF matrix capable of selecting any desired combination of bands.

Users in urban areas are having more and more trouble installing large antennas, so the satellite will have 10 dB to 20 dB more performance on each link. The 10m downlink will be capable of several hundred watts, possibly using the long solar panel wings for an antenna. The gain antennas for 2m and 70cm consist of several elements mounted on the sides of the spacecraft, each with its own amplifier with controllable phase, giving many possible antenna patterns. The satellite will be 3-axis stabilized using momentum wheels, so the antennas will always be pointing straight down at the Earth.

This new satellite will also have an elliptical orbit. We've learned an important lesson with AO-13: elliptical orbits are chaotic. It's possible (though not easy) to predict what will happen with a well-known set of initial conditions, but it's not possible to compute a set of initial conditions that will result in a desired orbit. So, to ensure that Phase III-D will have a long life in the desired orbit, it will be equipped with a motor that can be used many times to made adjustments to the orbit. The desired orbit makes exactly 3 orbits in exactly 2 days, so the groundtrack repeats every other day, with spectacular coverage. The German AMSAT folks negotiated a launch opportunity on the first experimental flight of the Ariane 5 rocket (we can't afford a launch like this on a proven vehicle).

Topic #3: TCP/IP and Internet

All sorts of packet-related goodies are available online on the Internet on the computer ucsd.edu and tomcat.gsfc.nasa.gov. Soon a dedicated host for AMSAT mail, amsat.org, will be installed at UCSD in San Diego under the supervision of network guru Brian Kantor, WB6CYT.

Phil Karn, KA9Q, added a hack to his TCP/IP software package to permit IP packets to be encapsulated inside IP packets. This permits packets from one amateur radio network to be sent to another amateur network over the Internet, without the intervening hosts needing to know about the amateur networks. At least seven "encap" gateways have been installed for this purpose: Honolulu, Sydney, Richmond, Chicago, Las Vegas, Geneva, and Ottawa. To install such a gateway just takes someone with both radio smarts and a good Internet connection. Is this amateur radio? Well, it sure is on the ends.

The Internet has proven to be a valuable resource. Encourage people to find a way to get on the Internet. The Internet powers that be have blessed this kind of operation as a legitimate use of the Internet.

Topic #4: World's Smallest NOS Box?

A HP-95LX palmtop computer was displayed running KA9Q NOS. It has both RS-232 and Infrared data interfaces.

Question: What funding is needed for Phase III-D?
Answer: The total commitment is about $3 million. The ARRL and AMSAT-NA have committed over $1 million, the rest comes from other national groups around the world.

Question: Is that realistic?
Answer: I hope so. If it isn't, and we can't get industrial sponsorships to fill the difference, the AMSAT's ability to develop bigger and better satellites is at an end. The amateur

satellite program puts amateur radio in the limelight as a technical pioneer.

Question: Is there time to get the satellite built?
Answer: Yes. But commitments have to be made soon.

Question: Is there a special fund for this?
Answer: Yes, the Phase III-D Spacecraft fund.
Followup: What do I write on the check?
Answer: "AMSAT" and lots of zeroes. You can earmark any contribution for particular projects if you want.

Question: Are there plans for a digital transponder?
Answer: Yes, in every path. Imagine having T1 rates or better on some of the microwave channels.

Question: How will the satellite know which way to point?
Answer: The idea of using GPS receivers to orient the satellite is still being investigated. The satellite will be outside the GPS orbit much of the time, so we need to know the antenna patterns of the GPS satellites (which aren't advertised).

Question: What data interface do the cellular radios have?
Answer: RS-422 differential.

Question: What about duplexers for all those radios?
Answer: We may just use separate antennas. We did get some duplexers and so forth with the cell hardware.

Lyle Johnson, WA7GXD, and Jack Davis, WA4EJR
Hardware Projects: Trakbox, Deviation Meter, Etc.

The Trakbox is a good example of a project that involved extensive international cooperation. Jack Davis, WA4EJR, was involved from the beginning, and TAPR got involved recently.

The project began in Sweden with amateurs using building block circuit boards from Micromint. These boards were based on the 8051 family of microcontrollers, and were originally published as projects in Byte magazine. Amateurs in Japan decided to make a special-purpose board to cut costs. Schematics and firmware were exchanged between amateurs in various countries using UOSAT OSCAR-14. The resulting board is now available as a kit from TAPR.

The board is a standalone rotor controller. This solves the problem of pointing the antennas at satellites, especially fast-moving satellites in low earth orbit, while also trying to do other tasks. The Kansas City Tracker has been available for a while now, but it requires an IBM PC, and takes up a slot, and requires the PC to be on during the pass. The Trakbox eliminates these limitations.

The Trakbox is based on an 8051 microcontroller with RAM and program memory, a realtime clock, and a LCD display. The user provides Keplerian elements through an RS-232 serial port, and then controls the operation of the Trakbox using the LCD display and front panel controls. The box interfaces directly to Kenpro rotators, and can be interfaced to other brands of rotator. The Trakbox can also control the receive frequency to compensate for Doppler shift, using either the computer interface or the up/down step buttons on Icom, Kenwood, or Yaesu radios.

A portion of the price of each kit sold is donated to the Phase III-D project. The documentation shipping now is preliminary. The assembly instructions are complete, but the operating manual is a bit primitive. Since the Trakbox is easy to use, this isn't too bad. The manual will be updated, and software development continues to improve speed and add features. Firmware updates will be free, or TAPR can reprogram the EPROM for the usual nominal fee.

A bare board identical to the one used in the RUDAK digital transponder was passed around.

A piece of unusual looking hardware mounted on a big round aluminum plate was displayed, and the audience was asked to guess what it was. It was a TAPR development project around 1985 that didn't

get a lot of publicity. It was a data collection and experiment control system for a payload built by a group of high school students in Dallas. It was flown in a GAS (Get-Away Special) Can on the space shuttle Discovery in 1985. Unfortunately, delays before and after launch proved too much for the batteries, and all the data was lost before it could be downloaded from the experiment.

The prototype of the TAPR Deviation Meter was passed around. A block diagram shows a 2 meter receiver with a 10.7 MHz IF followed by a second IF, followed by peak detectors feeding an analog-to-digital converter. The A/D converter is read by a tiny microcontroller, which also runs an LED display and an RS-232 port, and can output the measured deviation to either. The frequency synthesizer can tune any frequency in the 2m band. A calibration oscillator is on-board in the 10.7 MHz IF to permit the board to calibrate itself. Everything on the prototype is working, except a single buffer amplifier in the 135 MHz local oscillator. The prototype was used to test the 9600 baud modem kit.

Once the buffer amplifier problem is fixed, we can "turn the crank" and make a batch of the deviation meters available. TAPR has receive mail claiming that it's impossible to make a product like this for less than $100, but TAPR can!

Question: Does the TrakBox emit any RF at 2m?
Answer: Maybe a little, but your outside antennas probably won't hear it.

Question: Does the LCD on the Trakbox show the time to the next pass?
Answer: No, it shows the present time. It does have a (slow) future prediction mode via the serial port.

Question: How was this nice circuit board created?
Answer: Chuck Green, N0ADI, did the layout using ProCAD. TAPR uses circuit board fab houses in Tucson and in Orange County, CA.

Question: How fast can a new board be manufactured?
Answer: That depends on the cost. For a standard TAPR production run of 20 to 100 multilayer boards, it costs about $800 to $1000 per lot.

Mark Oppenheim, KD6KQ
VITA – Volunteers in Technical Assistance

VITA was founded 30 years ago by a group of scientists in Arlington, VA, to service as an information conduit to assist developing countries with their technical infrastructure. A staff of about 75 people presently answers requests free of charge. Many VITA volunteers are also registered with their areas of expertise, including N6ARE, WA7GXD, NK6K, HB9AQZ. In times of disaster, like the earthquake in Armenia, VITA coordinates donors, using their large communications setup at the office. HF packet and Pacsat operation are among the supported modes.

Since 1981, VITA has been working on using packet in developing countries. Local telephone systems are often like two tin cans with a bad string between them, and are unusable for data. Thanks to the amateur radio work in reducing the cost of packet radio, packet (on non-amateur frequencies) can be used to bypass the phone network. VHF packet was used to coordinate aid during the Ethiopian famine. Demonstration networks have been operated in Somalia, Lesotho, and Mozambique. An HF network is operating in Sudan.

VITA first worked with packet satellites using UOSAT-2. The software was too manual, and the satellite was so deaf that a large water buffalo would be needed to power the uplink transmitter. UOSAT OSCAR-14 was launched with partial VITA funding. Software delays and complexity were problems. VITA hired a programmer to develop simple-to-use groundstation software for their application, and they use Quiktrak for satellite tracking. The next step is to launch a dedicated satellite, VITAsat. There may be room for some amateur radio payload as well. A network with up to 500 groundstations in planned.

UOSAT OSCAR-22 was originally to be mainly used by VITA and Satellife, a group with similar purposes but oriented toward medical technology. The power amplifier on UO-22's non-amateur downlink failed, so satellite allocations between UO-14 and UO-22 were reshuffled. UO-22 is now 100% amateur, and UO-14 is 100% VITA and Satellife.

Numerous travelogue slides showed people, equipment, and camels.

Question: Are the locals generally able to operate the equipment?
Answer: Sometimes. Luckily, the equipment has been quite reliable so far, so no maintenance has been required.

Question: How is all this funded?
Answer: The equipment is purchased by the "customer". Some money is also available through grants. VITA does not charge for access to the satellite.

Question: Do you have difficulties with importing technology?
Answer: Sometimes.

Masa Sawada, JF2GPF
TASCO

TASCO was founded by JA2AQO, the current president, in 1979. TASCO began by selling weather facsimile terminals and RTTY decoder. In the mid 1980's, TASCO began selling amateur packet radio into the Japanese market under license from TAPR. They are constantly working on new technologies, and all technical staffers are amateur radio operators. Congratulations to TAPR on its 10th Anniversary.

To Be Continued

The next and final installment of the Blow by Blow Account will appear in the next issue of the Newsletter. Some of the best technical meat of the meeting is in the second part. Here's a preview of what will be covered:

? Bill Henry on Clover II, a new HF data modulation and protocol that promises great improvements in HF data performance.

? Gwynn Ready, W1BEL, on news from PacComm. They are getting involved with many new aspects of packet radio, including PACTOR and Baycom.

? Fred Treasure, KE5CI, on his packet-controlled astronomical observatory. It's quite a system!

? Lyle Johnson, WA7GXD, on bit-regenerating full duplex digipeaters. This is especially appropriate because TAPR's new 9600 baud modem contains the bit regeneration circuitry on board.

? Mike Curtis, WD6EHR, on his experiences with 9600 baud packet. Mike has been pushing 9600 baud up in the Los Angeles area for some time now, and his beginner's handbook is an invaluable tool.

? Eric Gustafson, N7CL, with his experiences with Mitrek and Tekk radios for data links at 9600 baud.

Proposal for SANDPAC Exhibit at the San Diego Computer Fair

Who We Are

SANDPAC is the San Diego Packet Radio Association, a group of San Diego amateur radio enthusiast who are particularly interested in using radio to link computers together. These links, called digital communications, take the form of direct station-to-station contacts, or relays through repeaters, worm holes and amateur radio satellites. SANDPAC is a member of an umbrella organization called SANDARC which acts as bank for resources used by member clubs for special activities. We are also loosely associated with TAPR, which is the defacto national packet organization, and with AMSAT, which is responsible for the amateur radio satellites and amateur radio aboard the space shuttle. One of the objectives stated in the SANDPAC constitution is to, "Encourage and educate interested persons or parties in the area of digital communications via Amateur Radio."

What We Would Like to Show

SANDPAC intends to prepare and man an exhibit at the San Diego Computer Fair to demonstrate what packet radio is for the non-technical, but scientifically minded person. The major aspects of the exhibit are:

A functioning packet radio station where an operator can send and receive radiograms via the National Traffic System. It usually takes a day or two for messages to be delivered to non-amateur parties. The purpose is to show how packet radio can be used to handle messages in disaster situations when normal telephone networks are down. Also, the operator can log into local packet radio BBS's and contact other packet radio operators.

Models of some amateur radio satellites. The microsats are 9 inches on a side and will be represented by a realistic model. Some of the larger satellites will be simple mockups and might be suspended over the booth. We may be able to bring some pieces of real satellites that were built here in San Diego.

An example of an amateur radio satellite antenna to stick up above the booth. The large antenna might be required by the packet station to operate inside the downtown building.

A computer running programs used by amateur radio operators. In particular, a program called InstantTrack has several very colorful displays of the relationship of the satellites with stations on the earth. In the fast forward mode this makes an eye catching animated display.

Pictures, displays and pieces of hardware as are available from the national organizations. Possibly a video loop on packet radio, amateur satellites or the space shuttle amateur radio activities.

Resources

SANDPAC will use the exhibit resources of SANDARC, TAPR and AMSAT as are made available to us. SANDARC has a display booth that could be used as part of the exhibit. Equipment, such as computers, radios and video displays will be supplied by the members or borrowed from associates.

Requirements

The exhibit will require 10 by 20 feet of floor area and will extend above the normal booth. 2000 Watts of 120 VAC power should be available.

Contacts

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