



PACKET

STATUS

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President's Corner

It has been a pretty busy spring as most of you read in the last issue. Laura, a good friend of mine, was injured during a University of Texas, Austin rock climbing outing to Heucos Tank near El Paso, Texas in March. Helping her recover from her emergency neurosurgery has taken up a lot of my time. Added to this, our office manager and my mother, Dorothy Jones, KASDWR, had surgery about 10 days after Dayton for a blockage of the lower intestine. The office is typically overflowing after our return from Dayton and now add to this Dorothy's being out of the office for four weeks means we have a big pile of stuff to handle. Then in June, I had my wisdom teeth out and to make things even worse I had a dry socket occur. The pain pills were a nice thing though :-). So, my TAPR time was nearly nonexistent for several months, which put several of my projects on hold.

Luckily, Laura is doing much better. Dorothy is on her way to a full recovery. My teeth don't hurt anymore. Which means I can get back to TAPR fun, at least after I return from my ice climbing/glacier course in August! A BIG thanks to everyone who sent e-mail, cards, and flowers to Dorothy while she was in the hospital. They aided greatly in keeping her spirits high during the time she was hospitalized and later recovering at home. She sends her best and hopes to talk to many of you now that she is back in the office.

Look for TAPR at these Upcoming Events

Sept. 25-27, 1998 ARRL & TAPR Digital Communications Conference
- Chicago, Illinois

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President's Corner, continued...

Don't forget that the ARRL and TAPR Digital Communications Conference will be held in Chicago, IL, on September 25-27. Proceedings deadline for papers is August 15th! Deadline for booking your hotel room if you are flying in or staying overnight is September 1st! This is a full month before the conference, so don't put off getting your hotel room now while room rates are at the conference price. We normally have the word out on the DCC a little before Dayton, so with the late start in spreading the word, please make sure that everyone you see knows about the conference.

The Digital Communications Conference looks to be a great event. CAPRA is the local host and PRUG (Packet Radio Users Group of Japan) is the international host! Steve Roberts, N4RVE, of Nomadic Research Labs, will be the banquet speaker on Saturday. Also, we have just received word that Dale Hatfield, W0DFO, recently appointed as the Bureau Chief of the OET (Office of Engineering Technology at the FCC) will be attending and speaking Saturday morning. See details later in the PSR for what else is happening this year at the conference.

As an update to the Digital Communications Conference, the ARRL and TAPR have renewed the Memorandum Of Understanding between the organizations for co-hosting the conference for another three years. As of right now, the 1999 conference will be held in either Phoenix or Tucson, AZ. If you want to help with the conference, please contact Dan Meredith, N7MRP (dmeredith@phx-az.com). The location for the year 2000 will hopefully be in the southeastern part of the US. There has been some interest shown in Florida, maybe Georgia. If your group is interested in hosting the conference in the future, just visit the DCC web page (www.tapr.org/dcc) and check out the page on hosting.

I had several e-mails and phone calls over the past three months from people concerned with the recent changes in the Field Day rules as they pertain to digital communications. The impression is that some changes need to be attempted to better reflect how digital communications are actually done. I'll be working with some people to see if we can at least have a dialog about the issue. Hopefully, we can see some changes that better reflect how digital communications are done today with APRS and some of the other modes.

As usual, Bob Hansen, N2GDE, PSR Editor, is always looking for articles or technical information to publish in the PSR. From reading all the e-mail in the last several months, people are doing things, so please take a few minutes to write it up and send it to Bob for publication in the PSR.

Until next quarter!

Cheers - Greg, WD5IVD

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

Article submission deadlines for upcoming issues:

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

Submission Guidelines:

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

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

1998 ARRL and TAPR Digital Communications Conference

September 25-27, 1998
Chicago, Illinois
(minutes from O'Hare Airport)
www.tapr.org/dcc

It's that time again! Mark your calendar and think about what to publish for the upcoming 17th Annual ARRL and TAPR Digital Communications Conference. This is the third year in which the ARRL Digital Communications Conference and TAPR Annual General Meeting are joined into one conference!

The ARRL and TAPR Digital Communications Conference is an international forum for radio amateurs in digital communications, networking, and related technologies, who meet, publish their work, and present new ideas and techniques for discussion. Presenters and attendees have the opportunity to exchange ideas and learn about recent hardware and software advances, theories, experimental results, and practical applications. The Digital Communications Conference is not just for the digital expert, but for digitally-oriented amateurs at all levels of expertise.

The 1998 ARRL and TAPR Digital Communications Conference will be held September 25-27, 1998, in Chicago, Illinois. This year's conference location is the Holiday Inn Rolling Meadows, just minutes from O'Hare Airport.

Not only is the Digital Communications Conference technically stimulating, it is a weekend of fun for all who have more than a casual interest in any of the ham digital communications modes. This includes APRS operators, digital networks, software writers, modem designers, and digital satellite enthusiasts. The ARRL and TAPR Digital Communications Conference is for all levels of digital operators — a must conference to attend to become active on a national level. Now, more than ever, amateur radio needs this great meeting of the minds because it is important that we demonstrate a continued need for the frequency allocations we have by pushing forward and documenting our achievements. The ARRL and TAPR Digital Communications Conference is one of the few ways to record our accomplishments and challenge each other to do more.

A Conference for the Beginner Too

The conference is not just for the digital expert. This year's conference again provides multiple session tracks for beginning, intermediate, and advanced presentations on selected topics in digital communications. Topics will include APRS, satellite communications, TCP/IP, digital radio, Spread Spectrum, and many others. Come to the

conference and hear these topics presented by the experts! Don't miss this opportunity to listen and talk to others in these areas.

Symposia and Seminars

In addition to the presentation of papers on Saturday, three symposia/seminars will be held. These sessions are provided to allow those with additional time and interest to make the most of the Digital Communications Conference. For those who may have interest in just one symposium or seminar, registration for the conference is not required to attend these activities. This allows maximum flexibility for those who may want to participate during the Digital Communications Conference, but do not have an entire weekend to devote to the event.

The Second APRS National Symposium will be held on Friday and will be moderated by Steve Dinac, K4HG (the developer of javAPRS). It will likely include many APRS software authors, such as Bob Brumling, W4APR (the father of APRS), Keith Sproul, WUZZ, Mark Sproul, KB2ICI (the developers of MacAPRS and WinAPRS), Brent Hildebrand, KHZZ (the developer of APRSPPLUS), and other nationally-known APRS leaders. Join this group for the afternoon and evening for in-depth discussions and presentations on the current and future status of APRS. This is a unique opportunity to gain insight into this fast-growing digital aspect of amateur operations that combines computers, packet radio, and GPS (Global Positioning System).

Starting late Friday afternoon, a half-day seminar titled "Infrastructureless Technologies in Amateur Radio," presented by Don Lemke, WB9MIN, will cover the pros and cons of DDMA (directivity division multiple access, a proposed infrastructureless technique) versus hubbed (cellular style) and other infrastructure dependent techniques, the basic problem of megahertz rate communications into the ham QTH, and some techniques for channel-area acquisition including full duplex/asynchronous versus simplex/synchronous radio/acquisition concepts. This seminar will start late enough on Friday afternoon to allow those flying that day to attend the seminar.

The Sunday morning seminar will be a combination of two different talks that will make one excellent seminar. The first presentation, by Lyle Johnson, WA7GXD, will focus on the upcoming RUDAK digital communications system scheduled to fly on the AMSAT Phase 3D satellite in the near future. Lyle will discuss features, systems design, integration, and experiments. The goal of the presentation is to zero in on the communications capabilities of RUDAK, the performance to be expected from the 153kb PSK system, the limitations and capacities of the DSP modems, user requirements for

receiving RUDAK, requirements for transmitting to RUDAK, and how amateurs can work to make ground operations a reality once the satellite is in operation. Information on how to submit a proposal for experimental time on RUDAK will be presented. The second presentation will be by Tim Shepard, KDIKY, regarding "Packet Radio Networks with Millions or Billions of Stations." This talk will present concepts and materials that make you think about different possibilities of networking in the future. Both Lyle's and Tim's presentations focus on different aspects of future digital communications possibilities.

Third Annual ARRL and TAPR DCC Student Papers Award

ARRL and TAPR especially welcome papers from full-time students to compete for the third annual student papers award. Two \$500 travel awards may be given, one in each of the following categories: a) best technical/theory-oriented paper by a student, and b) best educational or community-oriented application paper by a student. The paper should relate directly to a wireless digital communication topic (see the guidelines for more information). Papers co-authored by educators or telecommunications professionals are also eligible for this award as long as a student is the first author. The deadline for receipt of finished student paper manuscript is June 20, 1998. Please note that this deadline is different from the general conference paper submission date. For full details and paper guidelines contact TAPR or browse to <http://www.tapr.org/dcc>.

Call for Conference Proceeding Papers

Anyone interested in digital communications is invited to submit a paper for publication in the Conference Proceedings. Presentation at the conference is not required for publication. The primary purpose of the conference is to communicate ideas and techniques regarding digital communications. Papers written in an informal style are welcome, as well as those written to academic standards. If you know of someone who is doing great things with digital communications, be sure to tell them about this! Papers are due by August 15, 1998, and should be submitted to Maty Weinberg, ARRL, 225 Main Street, Newington, CT 06111, or via e-mail to lweinberg@arrl.org. The paper submission guidelines are available on-line (<http://www.tapr.org/dcc>).

Local/International Co-Host

The 1998 ARRL and TAPR Digital Communications Conference will be co-hosted by Chicago Amateur Packet Radio Association (CAPRA). CAPRA is one of the oldest packet radio groups in the US. It focuses on education about amateur packet radio, coordination of joint efforts of hams interested in packet radio, and technical and equipment support for a sound packet

network in the Chicago area. They have had high-speed packet networks operational since the mid-1980s. Visit the CAPRA Web site at <http://www.imaxx.net/capra> for more information.

PRUG (Packet Radio User Group of Japan) will be the first International co-host of the ARRL and TAPR Digital Communications Conference. The conference is proud to welcome PRUG as part of the conference. PRUG will be hosting an informal social Friday evening after the seminar and symposium are completed. Visit <http://www.prug.or.jp> for more information about the organization.

What can you expect during the 1998 ARRL and TAPR Digital Communications Conference?

- A full day of papers, breakout sessions, and selected topics on Saturday for the beginner to advanced amateur digital enthusiast.
- Three seminars/symposia:
 - Second Annual APRS National Symposium, moderated by Steve Dimic, K4HG (Friday 1 PM)
 - Infrastructure Technologies in Amateur Radio conducted by Don Lemke, WB0MIN (Friday 5 PM)
 - Future Synergy (Sunday 8:30 AM) Featuring: RUDAK Future Operations and Experimentations by Lyle Johnson, WA7QXD; and Packet Radio Networks with Millions or Billions of Stations by Tim Shepard, KDIKY
- Third Annual Student Paper Awards
- TAPR Membership Meeting
- A banquet with special guest speaker Steve Roberts, N4RVE, of Nomadic Research Labs. Creator of the Winnebago and Behemoth high-tech recumbent bicycles. His current project is focused on Microship technology (<http://www.microship.com/>).
- SIGs (Special Interest Groups) get-togethers on Saturday, following the banquet
- Informal get-togethers throughout the weekend
- A facility that is perfect for this type of conference
- Informal engineering discussions/demonstration areas
- Motorola Museum located in the area.
- An event at which the most important new developments in amateur digital communications are announced
- Digital 'movers and shakers' from all over the world in attendance

Conclusion

If you have attended a Digital Communications Conference in the past, remember how much fun it was discussing the latest developments into the wee hours! If you have never been to a Digital Communications Conference, then make your plans now to attend and find out how much fun they can be.

There are few activities where your participation can be so much fun and so important! You will be able to get together with colleagues from all over the world and bring each other up to date on your latest work. Experience all this and more for an unforgettable weekend of ham radio and digital communications. Make your travel and lodging arrangements now. We hope to see you at the ARRL and TAPR Digital Communications Conference, September 25-27!

Full information on the conference and hotel information can be obtained by contacting Tucson Amateur Packet Radio, 8987-309 E. Tanque Verde Road #337, Tucson, AZ 85749-9399, phone 940-383-0000, fax 940-566-2544, e-mail tapr@tapr.org, or browse to www.tapr.org/dcc.

Sincerely,

Steve Furd, WB8IMY, ARRL Conference Co-Chair
Greg Jones, WD5TVD, TAPR Conference Co-Chair
Steve Stroh, N8GNJ, Conference Manager
Mark J. Thompson, WB9QZB, Local Host Liaison
Carl Bergstedt, K9VXW, Local Host Liaison

Note: If you need conference handouts or flyers for ham club meetings, contact TAPR to get what you need!

Hotel Information

Conference presentations, meetings, and seminars will be held at the Holiday Inn Rolling Meadows. Special DCC rooms rates are \$85 per night. When making reservations with the hotel, be sure to indicate you are attending the ARRL and TAPR DCC in order to get the discount. It is highly recommended that you book your room prior to arriving. A block of 75 rooms is reserved until August 31, 1998. After the 75 rooms are booked, rooms will only be available in nearby hotels, so be sure to book your rooms early! The hotel provides transportation to and from O'Hare Airport. Please contact the hotel to arrange specific transportation needs.

Holiday Inn Rolling Meadows (conference hotel)
3405 Algonquin Rd.
Rolling Meadows, IL 60008
Phone: 847-259-5000, fax 847-259-0597

Registration

Contact the TAPR office by phone, fax, or e-mail (numbers and addresses are above) to register or for additional meeting information. MasterCard and VISA are accepted.

Pre-registration (before Sept 1): \$42.00 *

Late registration or at door: \$47.00 *

Conference registration includes Conference Proceedings, Saturday sessions/meetings, and lunch.

Saturday Evening Dinner (limited space): \$20.00
Includes dinner, speaker, and prize drawing

Seminar / symposia

Note: You do not have to be registered for the conference to attend one or more of the seminars/symposia. Cost of seminar or symposium includes the cost of handout materials.

Friday, 1-4 PM, Second Annual APES National Symposium (full day). Registration fee: \$25

Friday 3-7 PM, Infrastructure Technologies in Amateur Radio, conducted by Don Lcmke, WB9MJN. Fee: \$15

Sunday 8:30-11 AM and 11:30 AM-2 PM, RUDAK Future Operations and Experimentations by Lyle Johnson, WA7GXD, and Packet Radio Networks with Millions or Billions of Stations by Tim Shepard, KD1KY. Registration: \$20

AX.25 Version 2.2

Several members have commented on the Digipeating limitations discussed in version 2.2. Further discussions will take place at the DCC on this issue and some resolution will be offered to the community before the end of the year.

20th Anniversary of Amateur Packet Radio

Burt Lang, VE2BMO
burt@rodtec.qc.ca

It has been 20 years since the first amateur packet radio transmission. For more details on this historic event, see the following URL:

<http://www.cam.org/~burt/neda/pranni.html>

Happy Anniversary!!!!!!

Jamming Could Solve Japanese Noise Problem

Japan Ministry of Posts and Telecommunications

Japan's Ministry of Posts and Telecommunications may resort to cellular-frequency jamming to solve the problem of cellphones ringing in theaters and other public entertainment venues. Companies that want to provide such a service will have to be licensed and must prove that their systems will not interfere with legitimate cellular calls. Cellphones are cheap to free in Japan and so is the price of a wireless call. The mix of that and competition between several carriers has caused what the ministry has called a "tranquility" problem.

1998 Dayton

Greg Jones, WD5IVD

Dayton Ham Vention 1998 was so much fun!!! We had a ton of people attend and work the booth. The forum, while early on Friday, had really good attendance. The 169Kbps 900MHz Spread Spectrum link back to the booth for Internet access worked like a champ – unlike last year when the computer got smoked at the start of the day on Friday.

Thanks to all those who took time out to work the booth, answer all those multitude of different questions asked every year, and generally participated in being at the Ham Vention doing digital stuff. Dayton is fun, but it is a lot more fun because of the activities involving others that happen during the weekend.



John Koster, W9DDD using the SS radio link.
New TAPR banner is in background.

The new TAPR banner was unveiled at Dayton. At last year's DCC, the ancient/original TAPR banner was lost during shipping back from the conference. The container made it, but the banner wasn't inside. At Dayton this year, the new banner made its debut. Thanks to those that submitted concepts for the banner.

TAPR Digital Forum

This year saw another change in the digital forum. It was rescheduled for Friday morning and moved to a different room from year's past. We were a little worried that the earlier start might mean lower attendance, but that didn't happen. The room had around 200+ people the entire time of the forum. While our time was drastically cut from the previous year, we almost managed to get everything that we wanted to present into the forum.

Last year we had planned on having a live Spread Spectrum link between the forum room and the TAPR booth, but Murphy struck at 9am on Friday as we were setting up. This year we came prepared with two UPS systems for the booth and forum room. Thus, all the computers and radios were plugged into these. No fiery deaths of equipment this year. The Spread Spectrum link worked without a flaw and gave access to the local server in the booth and the Internet for the entire forum. At one point in the forum, we even broadcast the audio back to the TAPR site live. On Sunday, we used the link again to bring the audio from the Dayton Ham Vention Town Hall meeting to the Internet. That went without a hitch.



Steve Dimse, K4HG speaking during
the TAPR Digital Forum

We did capture all the audio from the presentations and they are now available on the TAPR virtual meetings page (<http://www.tapr.org/tapr/hum/virtual.html>).

TAPR Banquet and PacketBASH

The fourth annual TAPR Banquet and PacketBASH at the NCR "Sugarcamp" Conference Center had over 100 people attend. If you didn't make it this year, be sure to make it next year. Again, many thanks to John Ackemann, AG9V, and Fred Peerenboom, KESTQ, of the Miami Valley FM Association for their support of this event. During Dayton, we spoke briefly to the AMSAT organizers of their dinner about possibly combining the two events into one. Probably will not happen, but never hurts to talk about things.

Doug McKinney, KC3RL, talked about GPS and his busy projects in the Pacific. It was a very interesting talk, showing us a lot of big buoys that get dropped in the Pacific and how they get put together. You could tell Doug was very interested in this, since he ran over his time just a tad. As one XYL at the banquet stated, "it was the first

time I had heard such a good talk that focused not on the radios or packet, but on why radios were needed to make something happen. Everyone really enjoyed the talk. The audio from the banquet talk is available on the TAPR Virtual meeting page (see web page above). You'll have to listen to the audio to judge for yourself. Thanks, Doug, for an excellent banquet talk.



Doug McKinney, KC3RL, presenting at the banquet on Saturday night.

June TAPR 900Mhz FHSS Design Meeting

The development group met for a design review meeting on June 28th, 1998. The goal of the meeting was to set goals for the upcoming 6-8 months and review current progress.

As of the meeting, the digital board is about to be put into a second revision to eliminate the errors in the first board. Most of the digital board is fully tested, except for the ethernet interface. The interface shows intermittents during testing and the group feels that the cleaned up board should eliminate the problem.

The basic kernel is operational on the board, with the exception of the Ethernet driver module. The serial, timer, and several other modules have had to be rewritten from the ground up. It is expected that the ethernet driver may take 2 months to fully rewrite and get functional, since the manner in which the code handles the buffers might have to be optimized for our processor. As was discussed last issue, we have acquired a copy of XINU (a preemptive multitasking, prioritized scheduler) and a full-blown TCP/IP stack based on the design in the books by Doug Comer. We have to change the assembly modules, and port the code over from a SUN 3 workstation to the 68360 design. The total RTOS/STACK design is 630 different software code modules! Once the kernel/stack is operation, then we actually have to write the radio code. The Software Development Systems Inc (SDS) development tools have worked out very good. The tools include a Crosscode compiler suite and singlestep on-chip debugger.

Major goals achieved in the last 6 months include	
CPU operational test, register verification	Complete
verify BDM working	Complete
RAM+ FLASH testing	Complete
Ethernet I/F working formal	

Modify PCB artwork and rebuild CPU board Begun

Future goals regarding the CPU board include:

Develop simple stack running on commercial board	Partial
Exchange ethernet packets	
360 register I/O code	
PC display / control of 360 registers	
PC display / control of VLSI registers	
Write PIC & 360 code, use simple stack to verify	Started
all VLSI registers can be read/written	
360 can talk to/from PIC	
360 can read/write packets via Ethernet I/F	
360 can talk on HDLC to Viterbi chip for data	

As reported in the last report, the VCOs are operational on the RF board. Further testing of the RF board has been delayed while the group has focused on the digital board. The purpose being to get the digital board going so that more software people can be brought onboard to help, while the RF board gets worked on. Some of the goals regarding the RF board still include:

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

TAPR 900Mhz FHSS Project Fund Raiser

As published in the last issue, Bob Stricklin, N5BRG, Bill Reed, WD0ETZ, Tom McDermott, N5EG, and a highly competent group in support, are developing the TAPR 900MHZ FHSS Radio. We figure to spend at least \$10,000 this year on the project on things like another board run, software, parts, and other odds and ends that a project of this magnitude requires. Thus far, we have received a little less than \$2000 towards our goal.

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

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

Donations above \$25 will receive a certificate indicating funding of TAPR FHSS Radio Project, while donations of \$250 or more will receive a plaque to let all know of your efforts with this project. All donations are needed large and small.

YAM: Yet Another 9600 bps Modem (Part 2)

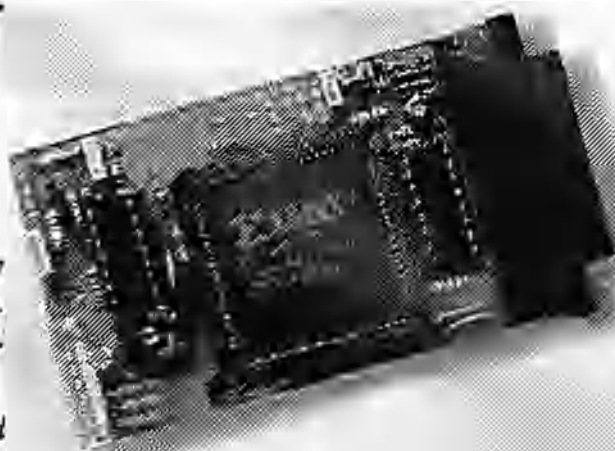
Nico Palermo, IV3NWX
 iv3nwx@microlet.com
 www.microlet.com/yam/index.html

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[Overview and History appeared in the last issue.]

The YAM is a FPGA-based FSK modem for Packet Radio. The modem is capable of 9600 bits per second operation and interfaces directly to the PC serial port from which it is also powered. It has a built-in HDLC controller which greatly simplifies the development of driver software and allows fast and reliable HDLC frame synchronization.

The complete schematic of the modem is shown in Figure 1. The circuit consists of the FPGA (Field Programmable Gate Array), a simple D/A converter, and buffer circuits.



YAM Logic Core

The logic core of the modem is made up of three main blocks: a transmitter, a receiver and a clock generator. The three blocks are independent of each other and connected to the Xc5202-6PC84C FPGA I/O pads as shown in Figure 2, the YAM Core Interface.

The core interface provides buffered paths to the modem core internal signals. It also provides an inverter used as the active element of the main clock crystal oscillator. An output buffer assigned to the LDC pin of the Xc5202 enables the PTT activation. During the FPGA configuration, the LDC pin is driven low by the FPGA internal logic, preventing transmitter activation during the configuration process.

The main clock divider is a 8 bit ripple counter. It is driven by the MCLK input (2.4576 MHz) and provides the required synchronous clocks to the remaining parts of the modem core logic (9.6 KHz, 76.8 KHz and 152.6 KHz for the transmitter, 2.4576 MHz for the receiver).

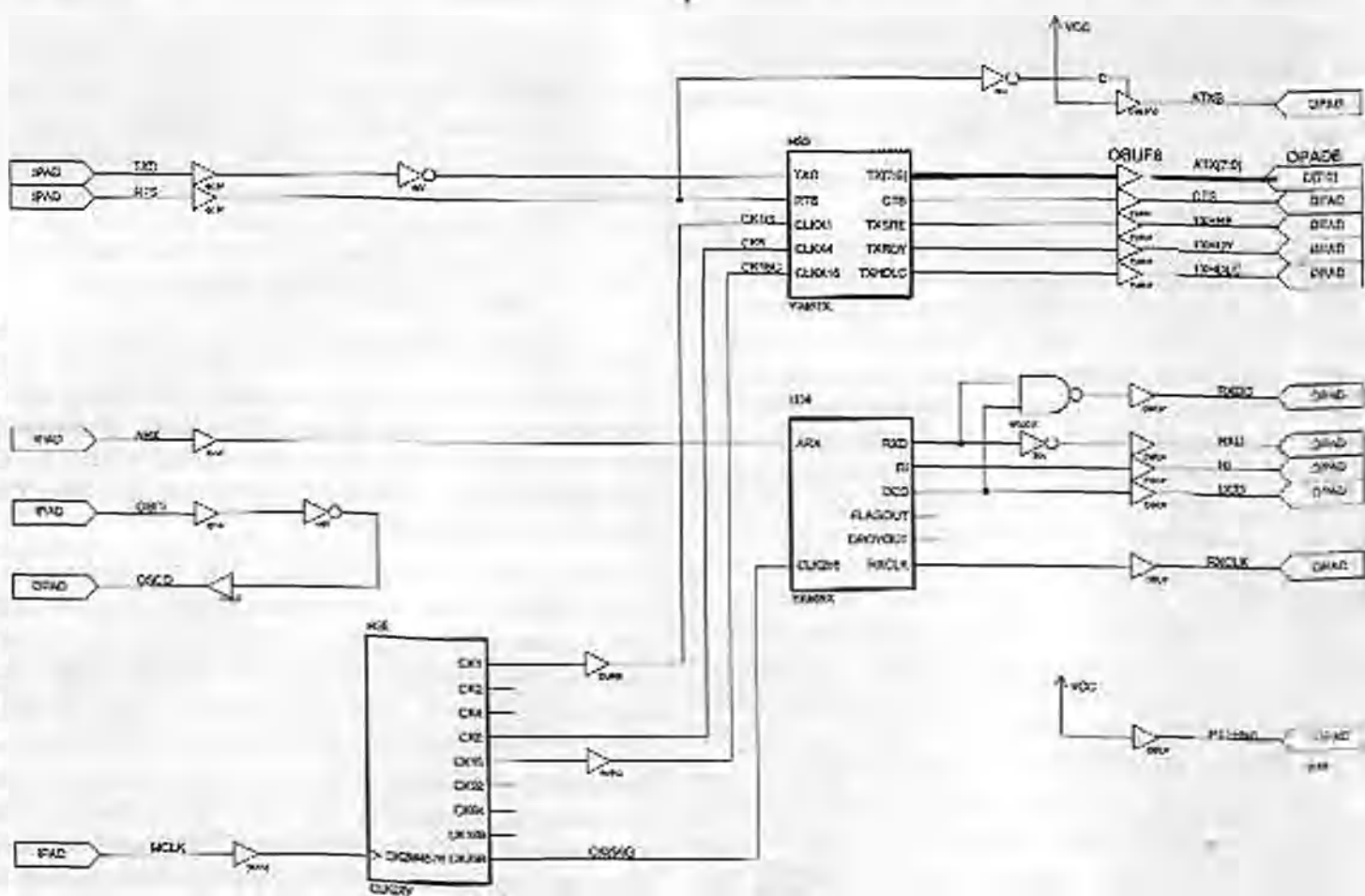


Figure 2. YAM Overall Core Logic

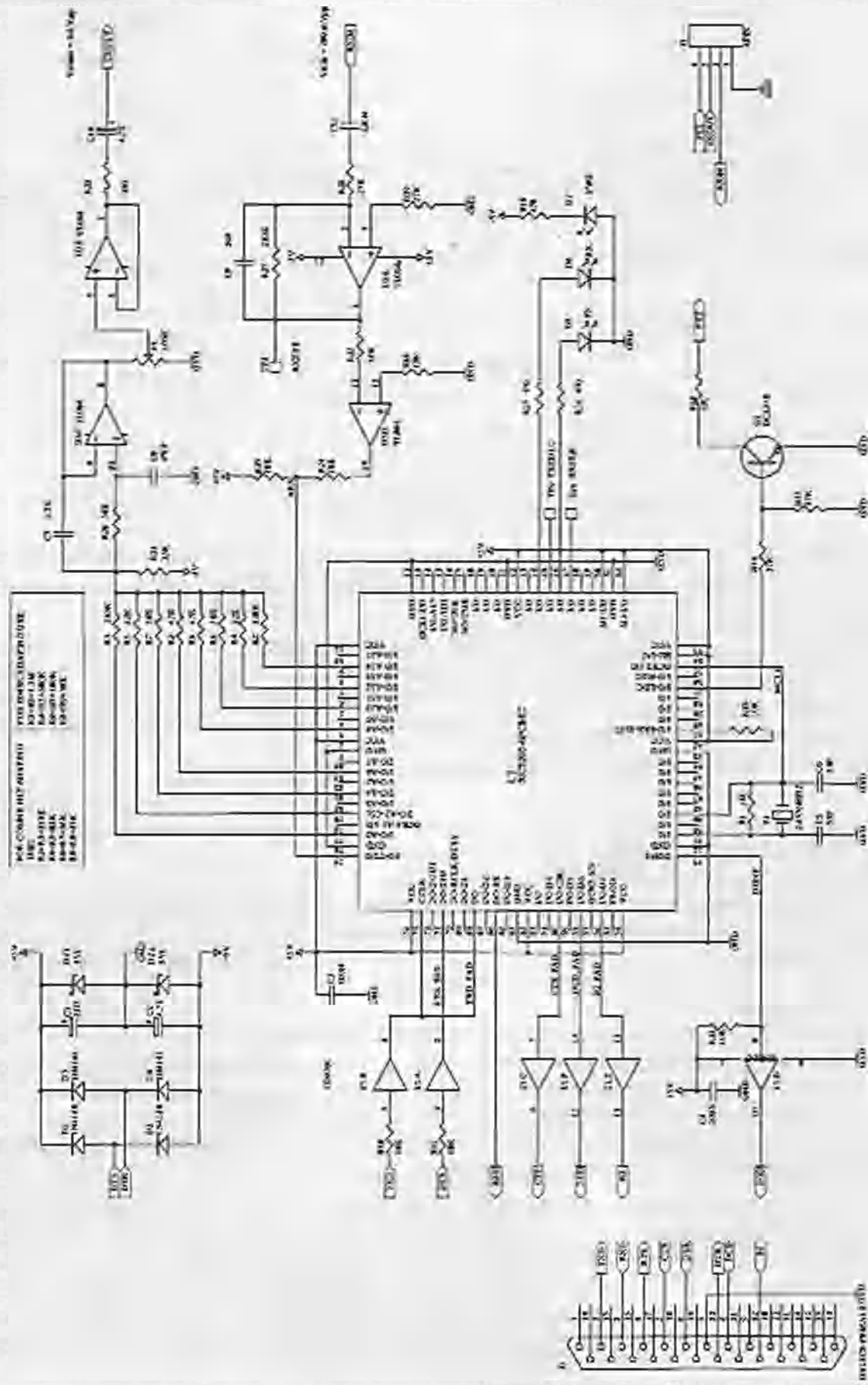


Figure 1. YAM Schematic

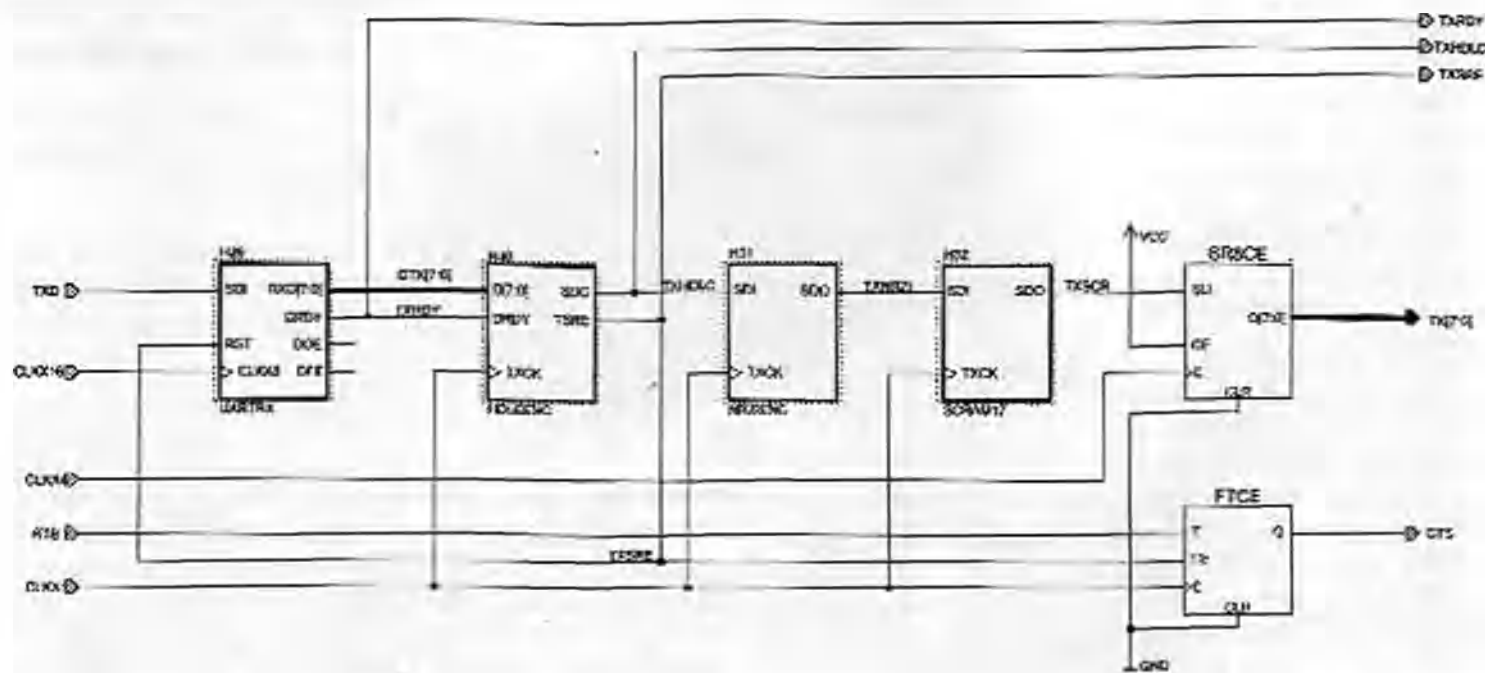


Figure 3. YAMTX - YAM Transmitter

YAMTX - Transmitter

The transmitter macro is a chain of five sub-macros (Figure 3). The serially received data fed a UART receiver, is converted to parallel form and passed to an HDLC encoder. The HDLC encoder processes these data and provides a serial synchronous data stream to the conventional NRZI encoder which in turns feeds a 17-tap scrambler. The scrambler output is shifted into an 8-bit shift register which provides the outputs for the digital to analog converter.

The CTS signal is generated by a T-type flip-flop which is enabled by the RTS signal and by the HDLC encoder TXSRE (Transmitter Shift Register Empty) output. It toggles every time the HDLC encoder has emptied the UART buffer to signal that another data character can be received from the serial interface.

HDLCENC - HDLC Encoder

The HDLC encoder (Figure 4) provides all the functions to encode the parallel data stream buffered in the UART receiver into serial synchronous HDLC frames. The CRC check/generation is not implemented but flags and zero bit stuffing is performed automatically on the basis of the UART receiver status.

An 8-bit parallel to serial converter macro (PSC8LP) with a HDLC flag parallel load and clock enable inputs provides the required serial synchronous data output. It is controlled by a counter which counts the number of bits actually shifted out. The counter outputs are decoded to generate the HDLC Transmitter Shift Register Empty output (TSRE) every time the contents of the parallel to serial converter are emptied. The TSRE output also drives

the load input of the parallel to serial converter and provides automatic HDLC flag insertion whenever the UART receive buffer underflows.

The zero bit insertion is performed by another counter which is disabled during HDLC flag transmission. This counter disables the parallel to serial converter and the main counter when a zero bit needs to be inserted.

NRZIENC - NRZI Encoder

One inverter and a T-type flip-flop perform the conversion of a NRZ encoded bit stream into a NRZI stream.

SCRAM17 - Standard 17-taps Scrambler

This is the standard scrambler for 9600 bps ham radio networks. 17 D-type flip-flops and a XOR gate is what are used.

YAMRX - Receiver

The YAM receiver is fed by the squared copy of the demodulated analog signal ARX. (See Figure 5.) The input signal is processed by an edge-detector which extracts the zero-crossing instants and drives a digital PLL (DPLL8EL).

The digital phase lock loop generates a sampling Prompt clock (CLKP) which feeds all the circuits in the receiver chain and it provides the Early/Late clocks (CLKE and CLKL) which are used by the Carrier Detector (DCDSEL). The data input is sampled, descrambled and NRZI decoded with the Prompt clock.

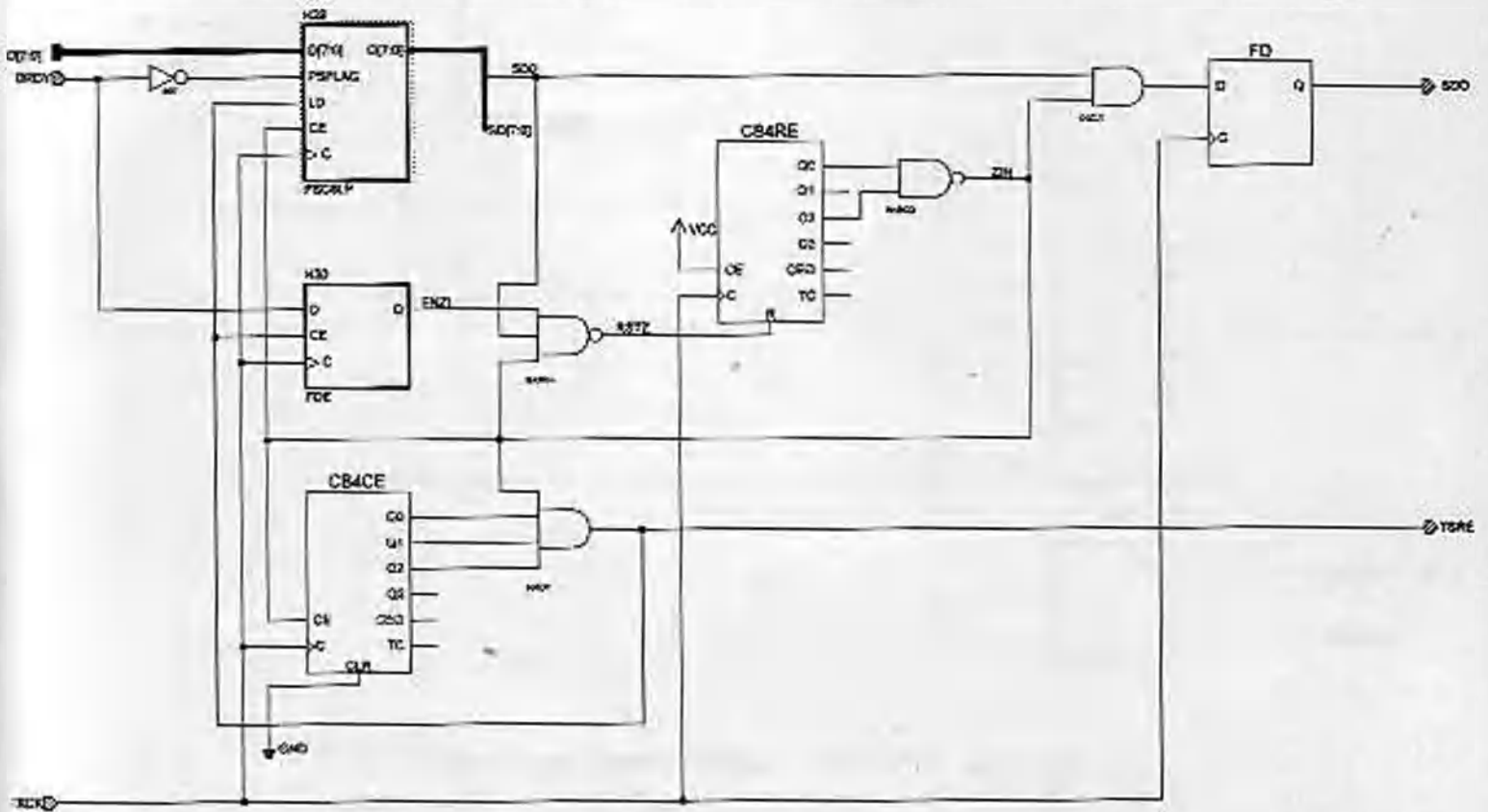


Figure 4. HDLCENC - HDLC Encoder

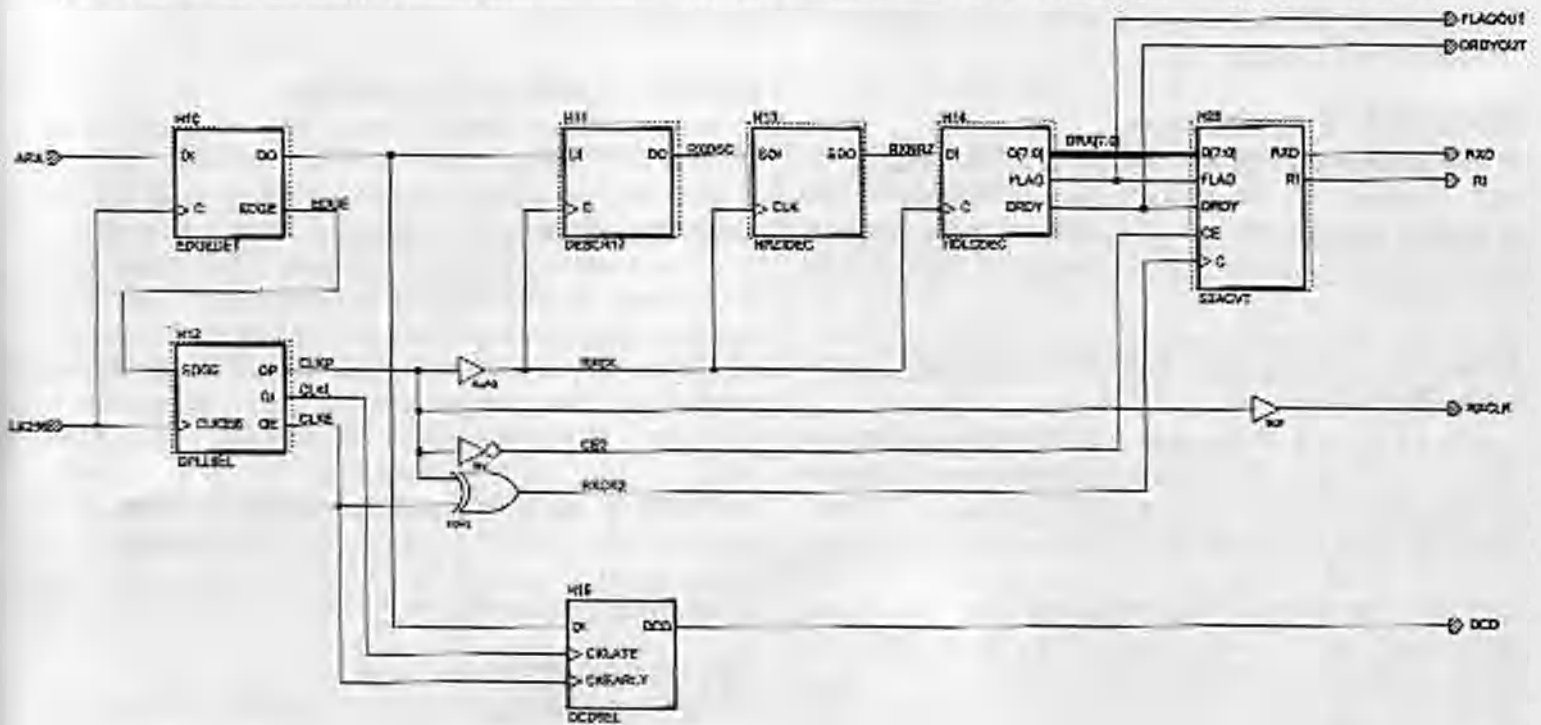


Figure 5. YAMRX - YAM Receiver

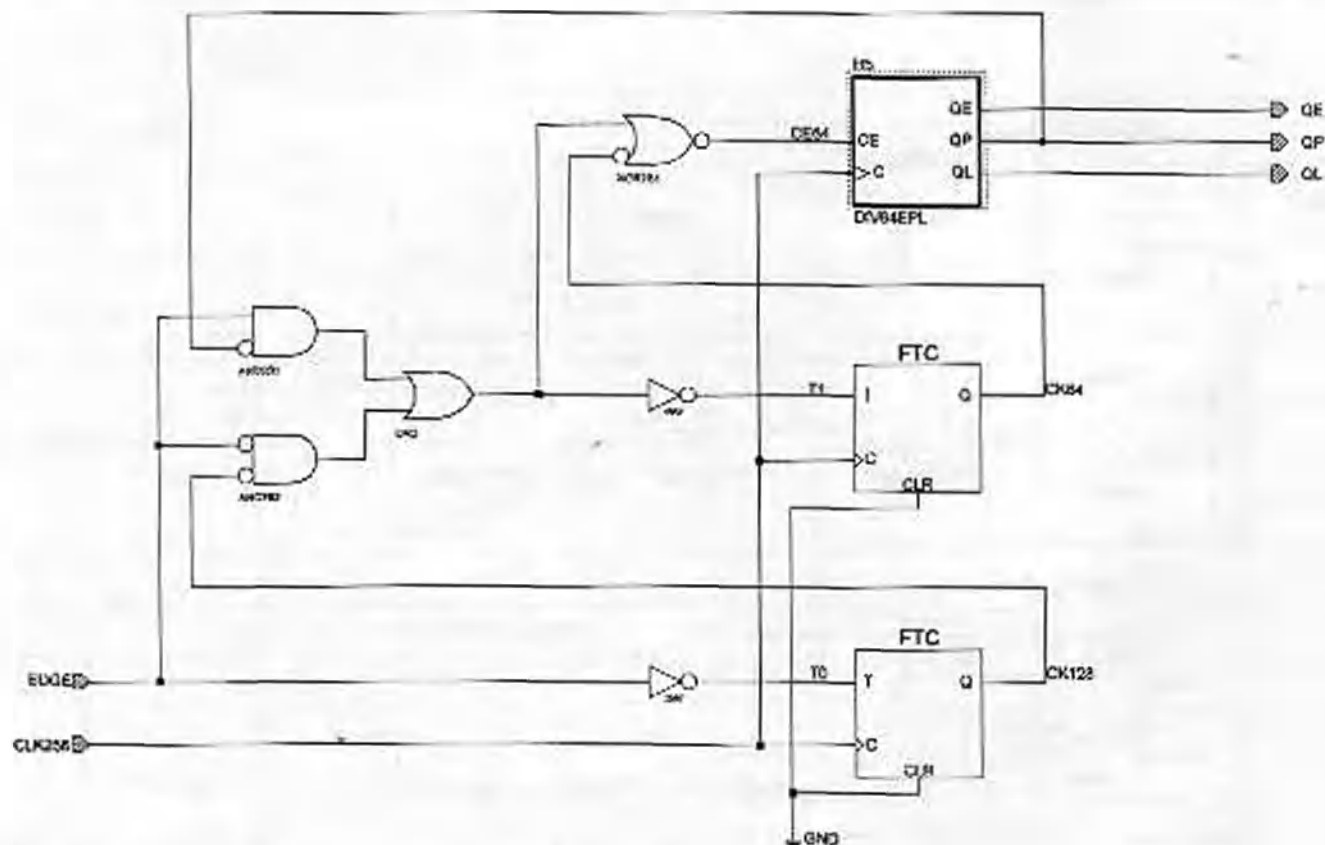


Figure 6. DPLL8EL - Digital Phase Lock Loop

The decoded output is then passed to an HDLC decoder (HDLDEC) which performs the reverse operation of the transmitter by providing a parallel data stream to a synchronous to asynchronous converter (S2ACVT). The converter translates its parallel input into the serial asynchronous RXD data output and provides a Flag Detect signal (RI) which notifies the host computer of incoming HDLC flags.

EDGEDET - Edge Detector

The edge detector provides an output pulse (EDGE) on each transition of the received signal. The macro also provides a delayed replica (DO) of the input signal which compensates for the delay of the pulse with respect to the input signal.

DPLL8EL - Digital PLL with Prompt, Early, and Late Clock Outputs

The DPLL is a phase locked phase-accumulator with 256 bit resolution. The price paid for such resolution is the high input clock frequency (2.4576MHz for 9600 bps) required. So it is not usable for much greater data rates. But it has the advantage that it requires only nine flip-flops and very few gates. The 6 most significant bits of the accumulated phase are generated by a /64 divider with a clock enable (DIV64EPL) which provides the Prompt, Early and Late clock outputs. The loop feedback logic controls the phase increment among three possible values - 0, 1 or 2 -- depending on the timing relation of the EDGE input and the local phase.

DIV64EPL - 6 bit Divider with Prompt/Early/Late Outputs

The divider (Figure 7) is a mixed synchronous/Johnson counter. The four most significant bits are counted by a Johnson counter to avoid glitches otherwise possible in the outputs. The Early/Late outputs are +/- 1/8 bit from the Prompt output.

DCD5EL - Data Carrier Detector

The data carrier detector (Figure 8) tries to analyze the input data eye-diagram and determine whether the input is noise or data. It performs this simply by XOR-ing two samples of the input data stream, one leading the correct sampling instant, the other lagging it. If the eye-diagram is open and the local clock is synchronous to that of the received sequence, the XOR result is always zero. On the contrary, in the presence of noise, there is a good probability that the polarity of the two samples is opposite. The carrier detector relies on this property and resets a 5-bit counter each time it detects opposite polarities on the early and late samples. Thus the DCD output is asserted only after 31 consecutive passes of the 'same polarity test' and the probability that it stays high when noise is received is very low.

HDLDEC - HDLC Decoder

The HDLC decoder (Figure 9) converts the serial NRZ input stream in a parallel form looking for HDLC flag patterns or zero filled sequences. Once a zero filled sequence is detected, a slave parallel converter (SPC82D)

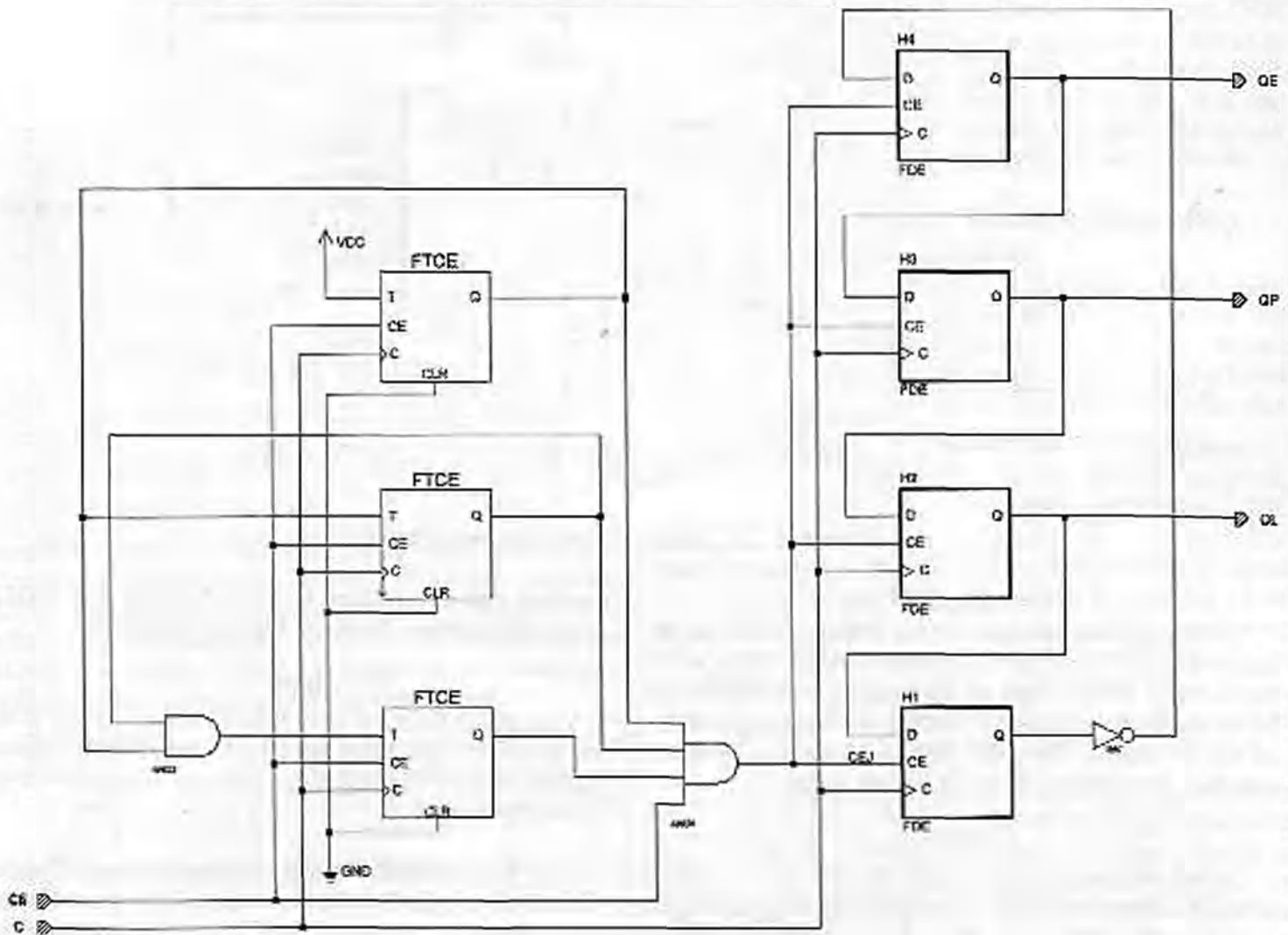


Figure 7. DIV64EPL - Six-bit Divider

is disabled to eliminate the zero bit added by the transmitter.

When a HDLC flag is detected, the zero deletion is not performed. In this case the counter of received bits is reset and the FLAG output activated. The counter is also disabled when a zero is eliminated. Its output is decoded to provide a Receive buffer full output signal (DRDY) which is activated when the slave serial to parallel converter is full.

S2ACVT - Sync. to Async. Converter (UART Transmitter)

The S2ACVT macro (Figure 10) reads the parallel data available from the HDLC decoder and converts it to a 19200 bps serial asynchronous bit stream.

The parallel data is serialized by a 10 bits parallel to serial converter (PSC10E macro). When the Load input is asserted a new byte is loaded from the data bus and prepared for asynchronous transmission to the host

UART with the insertion of one start bit and one stop bit (19200,N,8,1).

The Flag Received status input (FLAG) is latched by the Data Ready input signal (DRDY) and is output to the RI pin. The RI output is valid until the next received character is loaded into the transmitter buffer and should be polled as soon as the new character is available to the host UART.

The Serial Communication Protocol

The following are descriptions of the interface signals between the YAM modem and the host computer.

TXD - Transmit Data

During power-up this provides the clock pulses for the FPGA configuration process. During normal operations it carries the data to be encoded and transmitted by the modem.

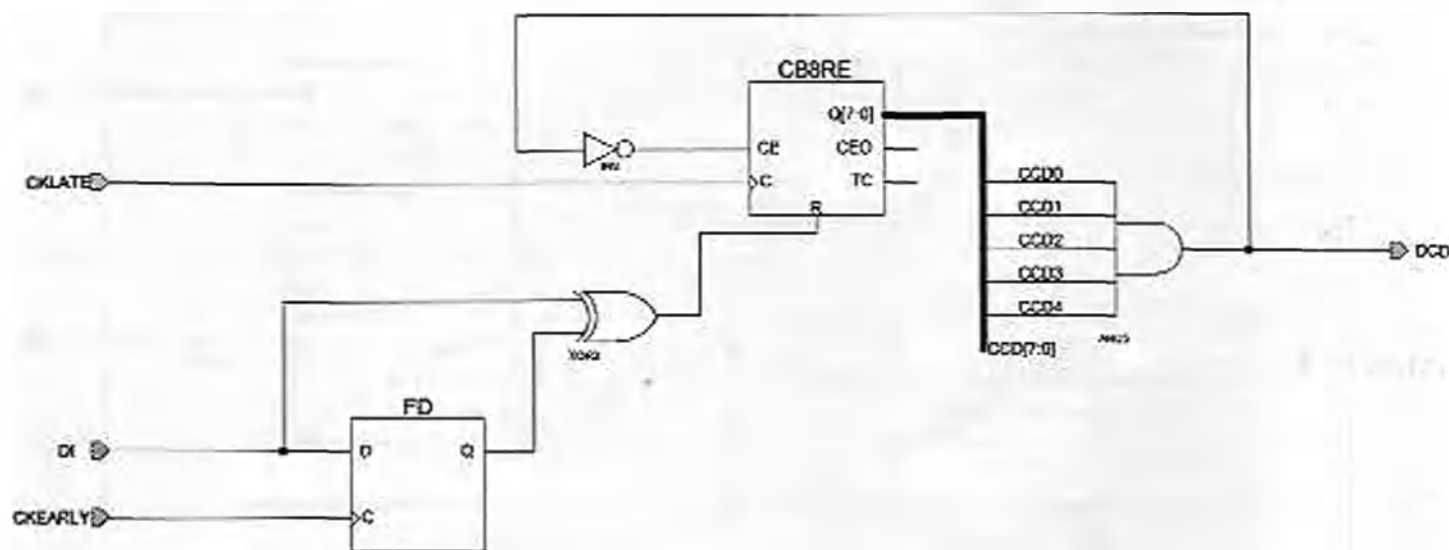


Figure 8. DCD5EL - Data Carrier Detect

RXD - Receive Data

Carries the data received by the modem. The received data is aligned on the byte boundaries of the last received HDLC flag. HDLC flags are also passed to RXD and can be distinguished from user data by monitoring the status of the RI signal. Received data is passed to the serial interface irrespective of the DCD line status.

RTS

Carries the power-supply to the modem in conjunction with DTR. During power-up provides the serial bitstream required to configure the FPGA. During normal operations is used to enable the transmitter. When RTS is

asserted the transmitter is activated and the HDLC controller begins to transmit flags automatically.

DTR

Used in conjunction with RTS to supply power to the modem. During normal operation, it is always negated with respect to RTS in order to continue to supply voltage for the board.

CTS - Transmitter Holding Register Empty Toggle

Used as a status line for the HDLC controller. During transmission (RTS active) the CTS signal toggles every time the controller is ready to accept and buffer in its holding register a new data byte. After a CTS toggle the

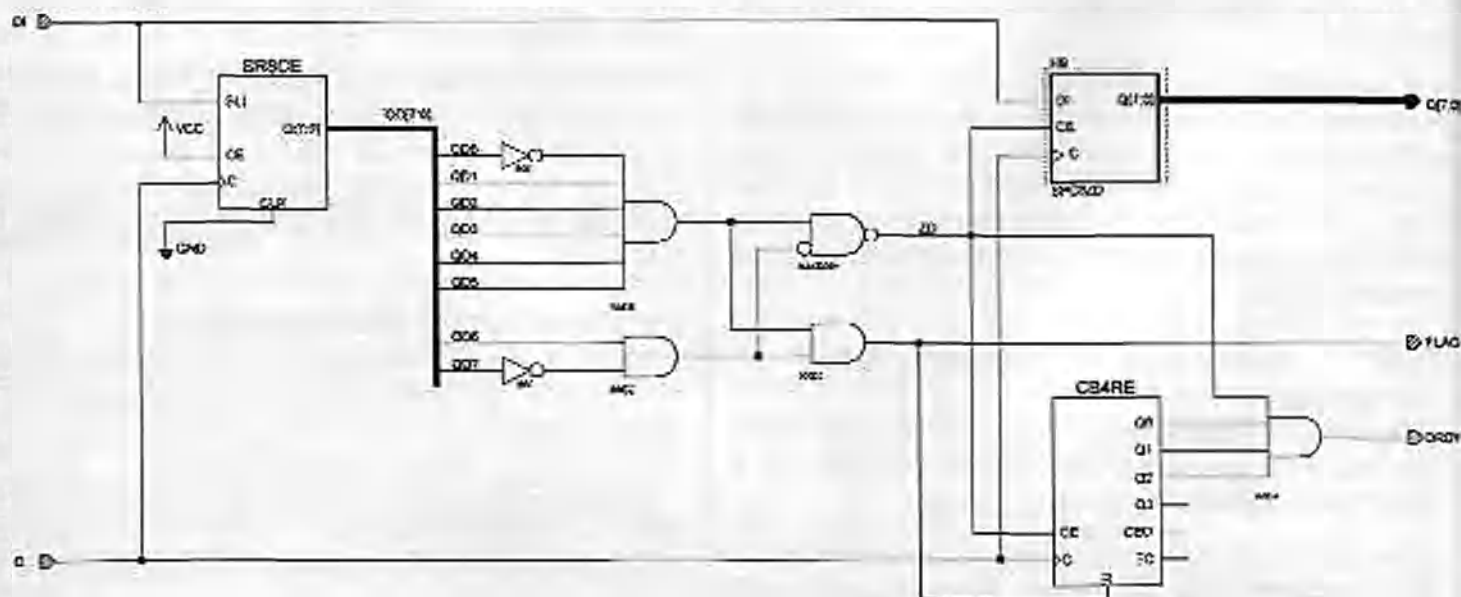


Figure 9. HDLCDEC - HDLC Decoder

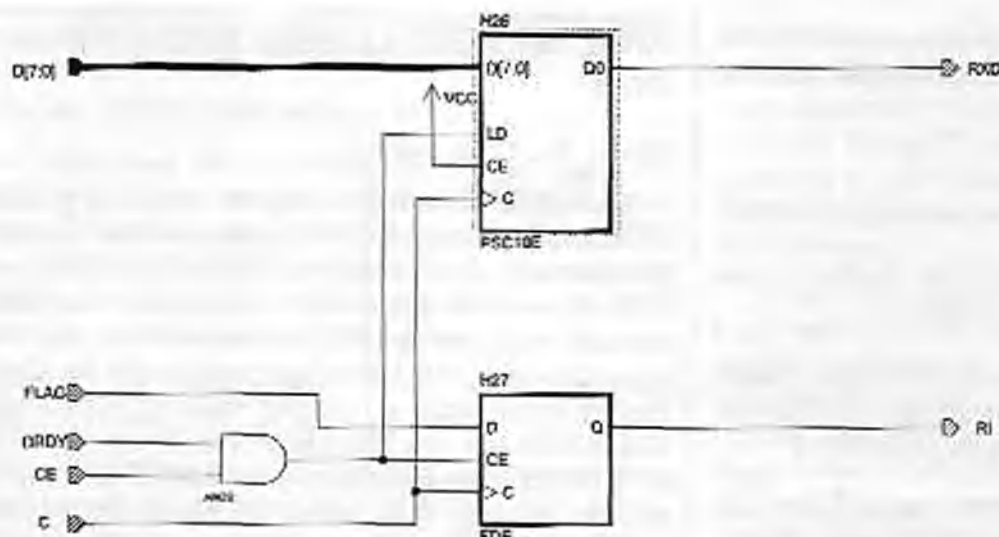


Figure 10. S2ACVT - Synchronous to Asynchronous Converter

controller waits for a data byte coming from the TXD pin. If a byte is received from the TXD pin before the next CTS transition, the byte is encoded and transmitted as soon as the TX shift register is empty. If the stop bit is not received within the next CTS transition, the transmitter will overrun and send an HDLC flag instead.

This mechanism provides simple and automatic flag insertion/zero-bit stuffing in the transmitted data stream:

- Whenever a flag transmission is required simply ignore a CTS transition.
- Whenever a packet of data is to be transmitted be sure to send each byte of it as soon as the CTS signal toggles.

RI - Flag Receive

RI is used as a status line that signals that a HDLC flag has been received from the analog input. It should be monitored as soon as a character is ready at the RXD pin to check if the incoming character is a frame header or a user byte.

DCD - Data Carrier Detect

This is the hardware carrier detect output. DCD goes high as soon as the modem receiver synchronizes to the transmitted data stream and a good eye-diagram is observed at the modem input. When noise or other than a baseband binary-encoded 9600bps waveform is received, the DCD is normally low with rare positive pulses. The receiver bandwidth should not be squeezed too much since the carrier detector relies upon the fluctuations of the received signal around the sampling instant and its performance can be degraded. Note that in absence of an analog input signal or if the input signal is very weak the DCD signal stays high.

DSR - FPGA configured

Used as a status line, DSR goes high when the FPGA is correctly configured. DSR going low means that the FPGA has reset and should be reinitialized.

Driver Programming Hints

1. Configure the UART for 19200,N,8,1 since the asynchronous serial interface has been designed to operate at twice the communication rate.

2. For packet reception, enable only the RX Character Available

Interrupt and discard anything received if the DCD signal is not active. When DCD goes active, monitor the status of the RI signal which informs you about the beginning of a new HDLC frame and gives you the opportunity to initialize your software for the buffering of a new frame. When the RI signal goes low and DCD is active, start to buffer the data available in the UART receive buffer.

3. For packet transmission, enable only the Modem Status Interrupt and then activate the RTS signal to enable the PTT. In the modem status interrupt handler, ignore as many CTS transitions as the flags that should precede the packet data field. Then start to write the packet characters to the UART transmitter buffer each time a CTS transition is detected and remember to ignore at least four CTS transitions before you deactivate the PTT signal to allow for final flags to be flushed.

4. Loopback operations are possible, but note that when the modem analog output feeds the analog input directly, the DCD signal will always be active irrespective of the transmitter enable status.

Modem Initialization Hints

The modem should be initialized before the software driver takes control of the serial communication port. The modem is initialized by uploading a configuration file through the serial interface. This task is performed by driving the TXD and the RTS pins with a serial configuration data bitstream and a serial clock respectively. Read the YAM Configuration Utility source code if you need to develop your own initialization program or embed it in your drivers.

After the modem has been initialized, the RTS and the DTR signal should never go low at the same time since the modem relies on these signals to sink the power-supply. Be sure that software other than the

initialization utility and the modem driver doesn't alter the status of the serial port signals as it could reset the FPGA.

Software Drivers

The following software drivers are currently available.

Linux Driver v0.2

Frederic Rible, F1OAT, has published the first release of the Linux driver for the YAM modem.

YAM FlexNet Driver v1.7

Thanks to the unvaluable work of Juergen Hasch, DO1SCR, the FlexNet driver version v1.7 supports packet operations with YAM under Windows 95.

TFPCX v2.71

The Firmware PC Extended (TFPCX) is now maintained by Henk De Groot, PE1DNN. Henk has revised it including the last TheFirmware version (TF2.7b) as well as added support for the YAM modem. I thank him for continuing to make the TFPCX software available and up to date.

SV2AGW Packet Software for Windows 95

George has added YAM support in his packet software for Windows 95. The VxD driver for the YAM, the terminal program, and a lot of nice packet software for Windows 95 is available directly at the SV2AGW Packet Radio Web Pages.

Nord><Link TFX_YAM

Nord><Link The Firmware eXtended (TFX) is a host-mode TNC-emulator for DOS. The software is subject to the ALAS license and any commercial use is prohibited.

NOS Packet Driver (still alpha release)

Acknowledgments

I would like to thank all the people who have contributed to the realization of this project. Many thanks to:

- DB2OS - Peter Guetzow, who kindly made available to me the Firmware eXtended source codes and let me develop the TFX_YAM host-mode driver,
- IV3VVV - Vanni Vettor, who engineered the YAM prototype needed to test the release v1.10,
- EB7GWL - Luis Yanes, who has drawn the PCB as soon as I published this project,
- IV3TIQ, Francesco Celli who trusted me and helped to better address my efforts towards the real needs of hamradio packet users,
- my wife Viviane for her patience when still waiting me for dinner at 9 P.M.,
- my 3 years old son Andrea who often asked me: "Daddy what are you doing so important?",
- again my son Andrea who suggest me to use a phase-accumulator DPLL for the rx clock recovery ;-)

If you have suggestions please let me know and forward your comments to iv3nwv@microlet.com

ARRL asks FCC to Deny LMCC 70 CM Grab

[From The ARRL Letter]

The ARRL has asked the FCC to immediately dismiss efforts by the Land Mobile Communications Council to gain primary access to 420 to 430 MHz and 440 to 450 MHz as well as other UHF allocations. The LMCC recently petitioned the FCC to reallocate the two 70-cm segments from the federal government to the Private Mobile Radio Service. Amateur Radio enjoys the use of 420 to 450 MHz on a secondary basis. In comments filed on RM-9267, the League said the LMCC proposed the switch "without establishing technical compatibility between PMRS operation and incumbent radio services in any of the bands sought."

The League said that existing federal government use of the spectrum precludes PMRS operation at 420 to 450 MHz. According to the ARRL, the petition fails to demonstrate any basis to withdraw the two band segments from federal use, nor any compatibility between PMRS operation and either federal government or amateur use. In addition, the League said, the petition fails to justify displacing established amateur operations. The League pointed out that the amateur community uses the band for public service and public safety functions and that hams have "substantial personal investment" in equipment that's in regular use there. The ARRL urged the Commission to throw out this portion of the LMCC petition "without further consideration."

The League backed up its arguments by citing documents from the National Telecommunications and Information Administration (NTIA), which manages federal spectrum. "NTIA has made it quite clear that there is no possibility of additional sharing of the 420-450 MHz band, and the unique relationship between Federal radiolocation uses and the Amateur Service cannot be duplicated by PMRS users," the ARRL said.

The ARRL said that the LMCC petition was premature because it did not take adequate account of the benefits of spectrum reforming already initiated. The League suggested that PMRS users adopt available spectrum-efficient technologies to maximize their use of existing allocations before seeking additional spectrum at the expense of other users. The League also said that PMRS users should look into using the Commercial Mobile Radio Service (CMRS).

A copy of the League's comments is available at www.arrl.org/news/bandthreat/RM-9267/arrl-cmt.html

Phase 3D Launch Date Unknown

[From the AMSAT News Service: ANS 172]

As announced via the AMSAT-BB, the Phase 3D satellite will not be launched on the third test flight of Ariane 5. The bad news reached Karl Meinzer, DJ4ZC, Phase 3D Project Leader and AMSAT-DL President on Monday, June 15th. He immediately informed the P3D Project workers of the unfortunate news.

AMSAT-NA President Bill Tynan, W3XO, had the following explanation for the decision:

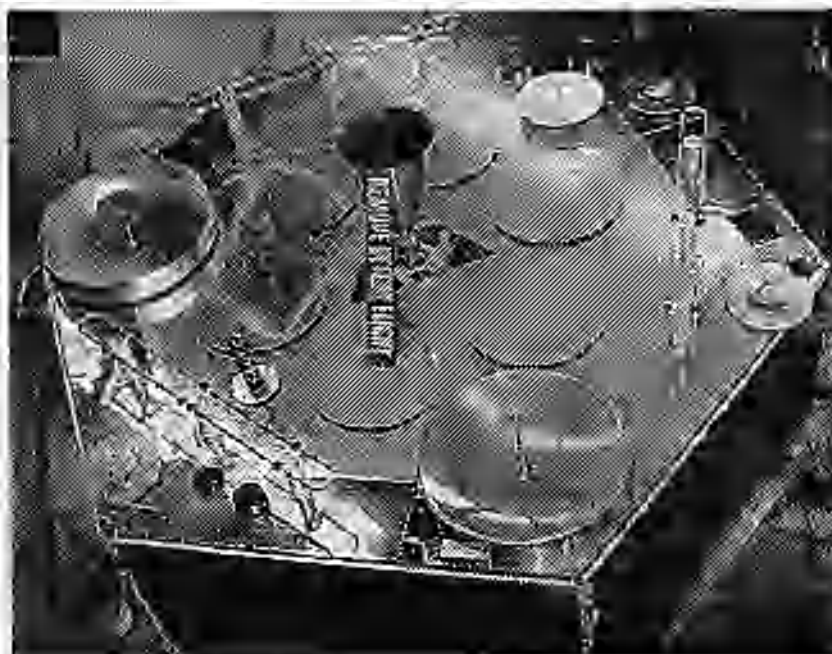
"It is important to point out that the decision was actually made by Arianespace, not ESA. As everyone should know by now, ESA is the European Space Agency. It is similar to NASA in the United States except that it is multi-national. Arianespace is the organization set up to market Ariane launches. So, naturally, its prime interest is money. Because of the failure of the first Ariane 5 test, A-501 in June of 1996, and the less-than-expected performance of the second flight, A-502 last October, all concerned have been understandably anxious to complete a fully successful test as soon as possible. Arianespace cannot begin to sell Ariane 5 launches until a successful test actually takes place. The failure of 501 and the lower-than-expected performance of 502 have caused an extension of the program and hence have increased the cost of the development phase. ESA has been anxious to recoup some of these additional costs. As a result, they asked Arianespace to try very hard to find a paying customer for A-503. A figure of somewhere around \$35,000,000 was mentioned. This is about half of the amount usually paid to launch a present-day commercial satellite on an operational launcher. The lesser amount is indicative of the fact that Ariane 5 is not yet fully operational. ESA even signaled a willingness to delay the flight until a suitable customer could be found. This shows how serious they were in wanting to recoup some of the financial losses they have suffered as a result of the delays and problems that have befallen the Ariane 5 program."

"Arianespace, apparently in order to get the A-503 flight off as soon as possible, and so that they could begin to sell future Ariane 5 launches, agreed to pay ESA some \$40,000,000 in order to control the payloads on the mission and get A-503 launched as soon as possible. It is not known at this time what Arianespace will chose to put on the 503 flight; it may even be a dummy satellite of some sort. The bottom line is that Phase 3D will not ride on Ariane 503," Tynan said.

"While we are disappointed, Tynan continued, "crying and gnashing of teeth never accomplishes anything." He emphasized that "AMSAT is taking steps to complete the testing of Phase 3D and have it ready for any launch that we might be able to obtain," adding "naturally, ESA and Arianespace are still prime candidates for our presentations."

Tynan emphasized that Phase 3D was designed and built "with the then very real prospect of a launch on an Ariane 5 vehicle." It was later determined that with an appropriate adapter, it could also be accommodated by an Ariane 4 launch vehicle. "But, because it was built to go on an Ariane, it just can't be put on any rocket that's going up," said Tynan. Continuing, he noted that Phase 3D is a "rather large spacecraft and also quite massive, in the order of 600 kilograms or about 1200 pounds when fully fueled. As such, it requires a launcher with a large volume under the shroud and a launch vehicle with substantial performance."

"The orbit that the launcher puts us into is also very important," Tynan continued. "Generally a geostationary transfer orbit is what we need. A launch into a circular low Earth orbit would be much less than optimum. Many launches, including the Shuttle, go to such LEO orbits. There are, of course, other launchers that go to GTO



Ready for Launch if the Gods so wish! Amsat P3D, 600kg, is the next ambitious of a long series of amateur radio satellites. With three-axis stabilization used for the first time, it will employ 3 magnetically suspended reaction wheels developed by Amsat Germany. It has a 400 newton N2-propellant motor as well as an experimental ammonia arc jet thruster producing 0.1 newtons. With its deployable solar arrays, it will have approx 600 watts of onboard power. Its payload will usher in a new era of amateur radio communications on bands from 10 meters through 24 GHz.

Among the other experiments aboard the craft, the Japanese branch of Amsat has supplied high resolution digital cameras that could provide some of the finest wide Earth photos since Apollo from an altitude of 45,000 km. The project represents the labor of hundreds of volunteers in more than a dozen countries. Is that not worth a bit more respect?

besides Ariane, and we will be looking at them. However, nothing can be promised at this time," he concluded.

Tynan told ANS that he hopes that AMSAT-NA members, and all who have contributed to the Phase 3D project to such a great extent, will keep the faith and continue their support while efforts to secure a launch for Phase 3D continue. He also made it clear that AMSAT is beginning to embark on other projects as Phase 3D is being completed. These include assisting with a number of university satellite projects, some of which are to include amateur transponders. Effort is also getting under way in connection with developing amateur radio equipment for the International Space Station. "In addition, I'd like everyone to remember that there are several satellites preparing for launch which will carry amateur transponders," said Tynan.

The AMSAT-NA president wrapped up his statement with: "there's lot's to keep all satellite enthusiasts occupied while waiting for the launch of Phase 3D, which will come in time. Just because Phase 3D will apparently not be launched this year, AMSAT is very much alive and kicking!"

Bad News on Phase 3D Launch

Bill Tynan, W3XO
President AMSAT-NA

By now many of you have heard the bad news that Phase 3D will not fly on Ariane 503.

This is, obviously very disappointing news. We must, however, persevere and continue our present course to get the satellite tested and ready for a launch. And we pledge to do so.

I think the situation is best summarized by the words sent this morning by Dr. Karl Meinzer DJ4ZC the Phase 3D Project Leader.

But first, a few words of explanation may be in order.

1. Ariespace is a commercial company set up to sell Ariane launches.
2. ESA is the European Space Agency, much like the U.S. NASA, but a multinational organization.
3. W1 is a commercial satellite built in Europe, which was damaged in a fire a few months ago. Reports have said that it has been refurbished and made ready for flight.
4. Although not mentioned in Karl's note, previous information has referred to CNES. CNES is the French equivalent of NASA. They have been designated by ESA as the technical agency in charge of developing the Ariane 5 launch vehicle.

DJ4ZC's statement follows:

Gentlemen,

First I would like to thank all of you who sent me notes of sympathy and encouragement following the recent news from ESA.

Since that information was released, I have spoken with many people and the situation has become a bit clearer.

First let me give a short rundown of events to put things into perspective.

1. Before the launch of AR 502, ESA terminated our launch-contract based on the fact that we "were not ready in time for the launch". This of course was due to the specification change which was imposed on us shortly before the launch following the AR 501 failure. We always maintained that the termination of the contract was on somewhat shaky legal grounds because of the unacceptable short notice we were given for the spec-change. ESA maintained that this was a risk we had to accept because the flight was a test-flight.
2. As a consequence of the AR 501 failure, a third test-flight (AR 503) had become necessary. Because there was an uncovered hole of about \$US 40,000,000. in the AR 5 development budget, ESA turned to Ariespace to find a paying customer for this flight and partly delegated the responsibility for the payloads to Ariespace. For the case that such a customer could not be found, the countries developing ARIANE 5 would have had to pay this missing sum.
3. In January we accepted the termination of the contract and with acceptable financial provisions without further squabbles after ESA agreed to:
 - a. Carry us as a backup on AR 503 if no paying customer could be identified.
 - b. ESA would use "best efforts" to place us elsewhere if a flight on AR 503 did not become available due to a paying customer.
4. While we always maintained that it would be unlikely that Ariespace would find a paying customer (and in fact we were proved right by the events) and thus we would be flying on AR 503, ESA always assumed that Ariespace would come up with a paying customer. Thus ESA unfortunately did not pursue the provisions of 3.a. in an active way. In particular they failed to perform the necessary studies to include us on AR 503 if the option 3.a. would have *to* be exercised rather late in the game.
5. In the ESA Programme Board meeting last week, Ariespace surprised everybody by stating that they (the company Ariespace) would cover the missing \$US 40,000,000 in return for having the freedom to decide the composition of the lower payload. So in fact

Arianespace had become the "paying customer" for this slot, and we were off.

Initially it was not clear why Arianespace would take this step. But after having spoken with many people, eventually the following picture emerged:

First of all, it is clearly in the interest of Arianespace to get AR 503 as quickly into orbit as possible. Assuming that ultimately they want to launch one AR 5 per month, each month of delay will cost them in the order of \$US 200,000,000 of lost revenue. This is all the more true since recently there has been some discussion about the performance of the AR 5 with regard to the market demands for launchers. So Arianespace may have some fears that they may lose the competitive edge if the AR 5 is further delayed and their customers may wander off to other launch-suppliers.

But also with AR 503 itself Arianespace looked into optimizing the cost/profit ratio. To this end Arianespace has been negotiating with the insurance about the damaged W1. If the W1 can be refurbished in time for the AR 503 launch, they would launch it and then sell the communication services themselves. I had earlier indications of this, but I did not take it very seriously because I assumed that Arianespace would stay away from this option in view of the resulting conflict of interest with their customers - it turned out that I misjudged this. So in a way we have become the first victim of this conflict of interest. But in the light of this gamble, it is now doubtful that Arianespace would have considered us as backup even if ESA would have done their homework. Clearly they want to retain the option of switching the refurbished W1 against the W1-dummy to the last second before the launch. We simply could not compete with this by our offer of \$US 1,000,000 and some moral justification of not flying ballast.

So we wept some, and that done - let us now look forward:

1. For ESA the launcher development has come to an end, and this phasing out is also reflected in the size of their staff and their commitments. So frankly, I do not expect very much from them in the future in spite of the above commitment 3.b
2. With Arianespace we have to start to deal in serious for a launch. In an initial contact they stated that they would launch us for \$US 10,000,000. Clearly for us this is out of reach, but I hope that, once Arianespace has a better understanding of our environment and the constraints we work under, there will be room for negotiation.
3. I expect that we will get some significant help from our government, [German] given that they saved quite

some money, and that this saving occurred essentially at our expense.

Also, all players agree that we have to finish the work on the spacecraft including the tests as soon as possible to be ready once the opportunity arises for a launch. It is clear that it will not be this year - but I think that the chances are not bad that we will find something next year on AR 5. This is all the more true given the mismatch of payloads with AR 5 performance.

But also in parallel we should and will pursue other launch options. Although in the short term we have a problem in the medium term I am reasonably optimistic. So keep your fingers crossed - I will inform you by this path on the progress we make in securing a launch.

Dr. Karl Meinzer, DJ4ZC
President AMSAT-DLc.V.
dj4zc@amsat.org

Phase 3D Lab WEB Site

Hello from Orlando

Few of you were aware that the Phase 3D integration lab has had a Web site for sometime. This was fortunate since there was nothing there worth seeing. We hope to change this with a few interesting additions. If you would like to share the progress a little more closely, join us at <http://www.magicnet.net/~phase3d/>.

Now, especially we need your support. "Always strive and never yield"

[The following From ARRL Headquarters]

The Ariane 503 announcement is the latest setback for Phase 3D. AMSAT has been trying to find a ride for Phase 3D for the past couple of years and, until now, had pinned its hopes on the Ariane program. AMSAT-NA was forced to restart its Phase 3D fundraising effort late last year after determining that it still needed at least another 270,000 dollars to meet its share of the Phase 3D costs. More recently, AMSAT-NA has been offering bams--for a 25 dollar minimum donation--the opportunity to fly their QSL cards into space aboard Phase 3D. Participants' QSL cards will be scanned and put on a CD-ROM aboard the satellite.

Phase 3D came closest to a launch aboard Ariane 502 last year but was bumped after it could not complete necessary structural modifications in time to meet the launch schedule. The changes became necessary at the eleventh hour after ESA imposed more stringent vibration and stress standards on Ariane 5 payloads.

TAPR DSP56002EVM Radio Interface with Enclosure Kit - Now Available

www.tapr.org/tapr/html/dsp56002evm.html

TAPR is now taking orders for the first round of DSP56002EVM Radio Interface with Enclosure kits until September 15th.

The kit provides:

- Interface Boards and Enclosure for the Motorola DSP56002EVM
- All parts included - including screws and standoffs
- Schematics and Documentation (Assembly and Operations)
- Software

A Motorola DSP56002EVM Evaluation Board IS NOT INCLUDED. These may be purchased from Motorola Distributors.

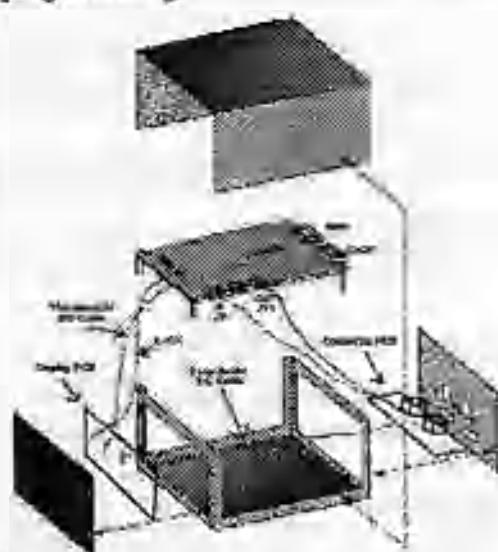
The price for the kit is:

\$135.00 US for members of TAPR

or

\$150.00 US for non-members

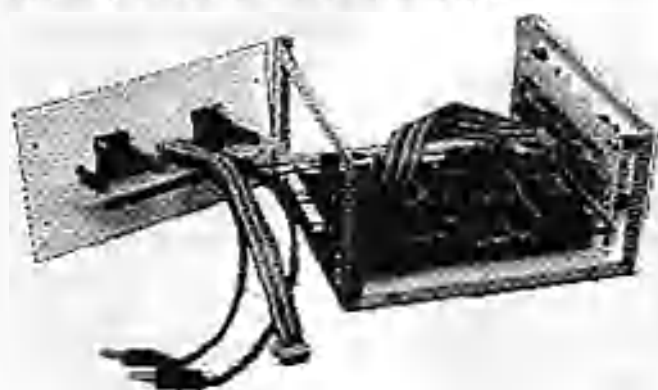
+ shipping/handling



This design of the radio interface for the Motorola DSP56002EVM is based on Johan Forrer's, KC7WW, original design. In February 1997, Douglas Braun, N1OWU, released his software suite for the EVM, based on the Finnish Alef Null group's work, and revised his interface to be more flexible than Johan's. The TAPR interface is a happy medium between Johan's and Doug's design. The goal is to make the interface flexible for past and present code developed for the EVM and to create a flexible programming interface for future programmers.

Once complete, the DSP56002 Radio Interface can operate as a KISS DSP modem or filter. Some of the DSP modems programmed are G3RUH 9600 bps, 1200 bps FSK, and 1200 bps PSK. Several experimental HF

modems have been programmed such as PSK31, MT63, and COEVM. An experimental group discusses these HF modems on TAPR's HFSIG (see SIG page to subscribe). Source code for all modems and filters are available for download (see DSP56002EVM web page).



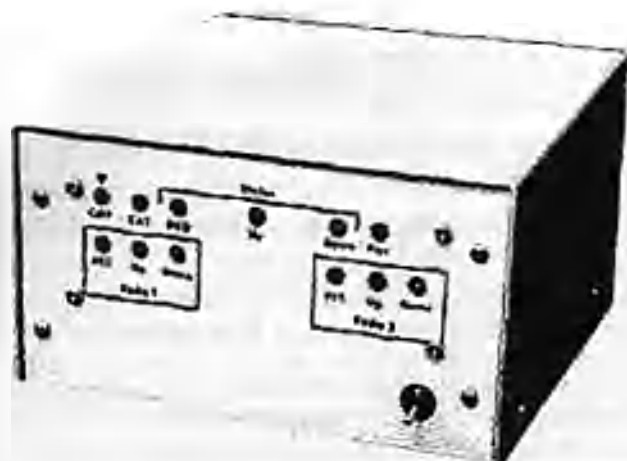
Side View of Unit (front is to right). The EVM sits in the middle of the enclosure with the radio interface to the rear and display to the front.

The development team consisted of:

Steve Bible, N7HPR,	Project Manager, Prototype builder
Lyle Johnson WA7GXD,	PCB design, Prototype builder
Johan Forrer KC7WW	Prototype builder
Tim Baggett, AA5DF	Prototype builder
Rich Mulvey, AA2YS	Documentation
Greg Jones, WD5IVD	Assistant Project Manager
Joe Borovetz, WA5VMS	Parts Procurement
Mark Hammond, KC4EBR	Beta Tester
Bdale Garbee, N3EUA	Beta Tester
John Koster, W9DDD	PCB Liaison, Beta Tester
Keith Justice, KF7TP	Beta Tester
John Ackerman, N8UR	Beta Tester
Frank Perkins, WB5IPM	Beta Tester
Steven Taff, KA1WX	Beta Tester
David Borden, K8MMO	Beta Tester
Louis Cobet, K6MDH	Beta Tester
Jim Lynch, K4GVO	Beta Tester
L.J. Shephard	Beta Tester

TAPR kits can be complex depending on the kitting experience of each builder. We don't think you will have trouble with the interface kit, but it does require some knowledge and experience to successfully go from a kit to a finished, usable unit, depending on the mode of operations. For data radio applications (i.e. 9600 baud FSK), special modifications must be made to your radio for proper operation of the EVM interface. In addition, the interface kit requires that you have a Motorola DSP56002EVM Evaluation Board. These can be purchased from several electronic distributors (see web page).

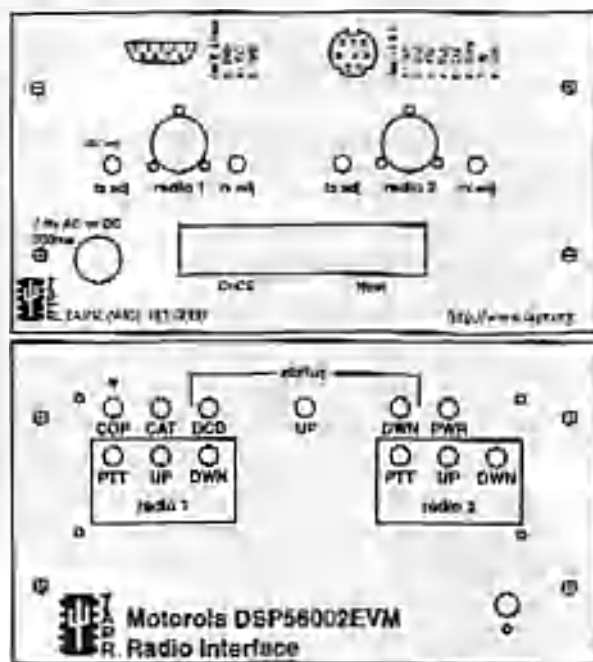
TAPR requires that kit purchasers provide VISA/MC information or checks/money orders with their initial



Front View of Enclosure

purchases. Money for the initial kit purchase will be deposited on September 15th, 1998 to cover kitting costs. Orders will be taken for the first 200 units. If more than 200 units are ordered, then a second or third batch will be done as soon as additional parts inventory can be purchased and kitted. In this way, the interface kit will be provided in the exact numbers required for the demand. After this initial kit offering, EVM interface kits will be provided in batches as the demand warrants doing kits. The initial batch of kits will be as large as the demand requires, which we hope is large. The more the merrier!

EVM interface kit orders for the initial purchase will be taken until September 15th, 1998. Orders can be mailed to the TAPR address: 8987-309 E. Tanque Verde Rd #337, Tucson, Az, 85749-9399, call (940) 383-0000 (Office Hours: Tue-Fri, 9am-12noon, 3pm-5pm Central Time), or fax (940) 566-2544. If you have questions concerning the unit, check the web page.



Connect Request

NZART Conference

I am involved in organizing the NZART Conference for 1999, in early June next year. Could you see if any of your key members may possibly be in New Zealand around that time that could be a keynote speaker for us. Thanks.

Steve Davis, ZL2UCX
 steve.davis@trimble.co.nz
 steve@zl2ucx.gen.nz

Digital Communications and the Year 2000

Where can I get information about what problems digital ham networks will face with y2k? I have a node, the WZ9M node, as part of the GL network. I haven't been able to get any info. so far from local resources. Any information would be helpful, thank you.

Jon Slough
 jonslough@tin.net

I also passed this message on to the NEDA group (North East Digital Assoc), and their comments were pretty much the same as mine:

No problem. None of the networking software, at least that we know of, will be affected. Some user TNCs might display some dates funny, but since no calculations based on year are performed, it won't matter. An accessory program that is distributed with BPO displays the year 2000 as "0", but again, it's not used for calculations anywhere.

Nobody's ever had a look at NOS, though. Shouldn't be a problem, Linux is generally smart about such things.

Some BBSs might get messed up, but nobody seems to care much. I'd imagine that the newer stuff uses a 4-digit date, and if not, operation could be restored by blasting away any archived messages from 1999 and earlier.

I'd be interested in hearing anything else you might discover.

Don Rotolo, N2IRZ
 N2IRZ@compuserve.com

GPS-25 1 pps, Oncore & Rb Comments

Dr Thomas A Clark, W3TWT
tac@clark.net

Several questions have come up recently.

Chris Elmquist wrote:

Can anyone comment on the precision of the 1 pps output from a GPS-25? Is it better than the GPS-20? Is it the same? I'm considering an engine for the July QST controller project and want to understand what performance differences might be encountered between the GPS-20 that I already have, a GPS-25, a Motorola UT+, or a Motorola VP.

The GPS-20/30 is a POOR choice for use as an oscillator stabilizer. As you can see from the plots on my aleph lip site at

http://aleph.gsfc.nasa.gov/GPS/totally_accurate_clock/

the various Garmin plots show that the GPS-20 timing has erratic jumps at levels of 1 usec. This is presumably due to the sequential receiver re-assigning & resetting its resources whenever it feels like it. A GPS-20 will most certainly degrade the performance of any fairly good xtal or Rb that it is used with.

The GPS-25 shows other strange behavior such as ramp-like timing drifts with rates of $1:10e11$ to $1:10e12$. During the tests I ran, I saw the GPS-25 drift off UTC by an amount of up to +/- 10 usec. It would probably work to control the rate of a crystal down to levels $1:10e10$ or so.

The ONCORE UT+ has not been tested in detail, but should work about as well as a VP. The VP is my choice over the current UT+ since it has so many other capabilities -- like acting as a DGPS base station, and being able to "talk" NMEA. I also believe that the VP version that TAPR is now offering includes Option "C", which includes a carrier phase output capability. There is some work in progress which will allow an ONCORE VP with Option C to generate RINEX files for post-processing at levels of a few cm.

Don Hasselwood added the question:

Add the Motorola Remote GPS to the list for comments. It looks like it's designed for timing use and ideal for fixed-base operation. I don't know how much it costs, though.

I believe the original UT is now obsolete, having been replaced by the UT+ EXCEPT that Motorola is using the old UTs in their pod-mounted antenna/rcvr combo which still tests out to be an old UT. The price of this widge is \$500, without cables, without a

special connector that is needed, and without the RS422 to RS232 converter, power supply interface, etc. that is needed to make it work. In my humble opinion, it isn't too good of a deal!

Regarding the Rubidium clocks, John Pringle asked:

Since most of us have now received our Efratom FRK-L Rubes from Lehman, I was wondering if we ever made a final decision on exactly which internal connections to bring out to the multi-pin connector for interfacing to Tom's forthcoming TOC or to Brooks Sierra's controller which appeared in July QST. I looked back through all messages that I could find on the subject but I couldn't find where we actually decided on the exact connection points to bring out. I would like to fire up my Rb for the first time but thought it would be a good idea to make the modification first so it would be a simple task to connect it to the GPS controller without having to power down the Rb. I think it would be a good idea to choose the pins on the multi-pin connector to use just for the sake of uniformity. Looks like pins X and V might be a good choice since they don't appear to be used. Any info, suggestions or comments would be appreciated.

One thing to remember is that Brooks' controller produces a VOLTAGE output. The only control of the FRK and M-100 Rb's is by injecting a CURRENT into the "C-field coil". The FRK & M-100 Rb's are slightly different (there was a LOT of discussion on this topic on TACGPS about 2 months ago) and the parts designations and "magic connection points" are slightly different. I have designed, but have not finished the documentation, on a "suggested standard Rb interface" so that we all will use the same connector pins, and can communicate about it sensibly. Alas, I have not had time to modify my M-100 and FRK units to test it, and hence have not finished the documentation.

In Brooks' QST paper he shows that his unit can be used in the "learning mode" to compare the oscillator to GPS. I would STRONGLY advise that you spend some time running it in this mode to see just what level of control is needed/desired.

Just remember that the short-term stability of the Rb is no better than the crystal inside the Rb. In fact, it is WORSE! The way that the Rb works is that the crystal is FM'd by 20-30 Hz at the 6.8 GHz Rb spectral line, and the crystal is controlled so that the average of the positive and negative frequency offsets from 6.8 GHz is zero. This modulation (as I recall) is at 127 Hz in the Efratom units, so you should expect to see 127 Hz FM in the output. If your goal is to use the oscillator as a frequency standard for microwave applications, I'd recommend finding a good crystal!

TAPR Spread Spectrum Publication

The SS Update publication is in layout and should be available around the end of September. The collection of articles on Spread Spectrum covers a range of issues on Introductory/Informative, TAPR related, Regulatory, and Technical/Theory. Tom McDermott, N5EG, provides the foreword for the book:

This book provides an extremely broad treatment of the subject of spread spectrum systems as applied to amateur radio. While little technical and social literature exists on this subject, the publication provides a convenient compilation of a fair amount of the significant work. It should appeal to an audience with a wide-ranging interest in the subject.

There is, apparently, much misunderstanding of the application of spread-spectrum techniques to amateur radio. A classic introduction to the subject written by Costas (in 1959, no less) provides a view of the efficiency of spectrum utilization. His material is timeless and still relevant today, as the recent upsurge in CDMA-based personal communications systems (PCS) amply demonstrates.

The difficulty in applying such techniques to amateur usage perhaps has to do more with the lack of surplus SS (spread spectrum) equipment than with any other factor. Today most of the VHF and UHF amateur bands consist of warehoused spectrum — FM repeaters are assigned exclusively to channels based on the first-application for the spectrum. However it can be readily shown that, on average, the spectrum is significantly under-utilized. This is because the repeaters are mostly not emitting a carrier at any given instant in time. Therefore a statistical technique can be applied to understand the usage of the spectrum. In the case of on-off emitters, far better utilization of the spectrum can be made with spread-spectrum techniques.

One way to visualize this is to look at the telephone system. It has long been known that most people make local calls far more often than they make long-distance calls. Thus, a local telephone switch does not need to have nearly as many long-distance trunks (which are expensive) as it has telephones connected to it. In fact, as the number of users of the switch increases, the probability that a large number of those users all simultaneously wanting to access a long-distance converges asymptotically to the average value with the deviation decreasing rapidly. Essentially the same thing happens with a large number of amateurs attempting to access a limited amount of spectrum — the probability that they all want to transmit at the same time converges to the average value. This means that one can engineer the spectrum utilization to the average value, not the peak value. A glance at traffic engineering tables will illustrate the profound efficiency of this type of

engineering. Thus, the conclusion that assigning and administering FM repeaters based on SS techniques could essentially totally eliminate the current stoppage on these allocations.

Trunked systems and SS systems are both approaches to such dynamic utilization. Trunked systems allocate shared narrowband spectrum in a dynamic fashion, whereas SS systems can be viewed as allocating wideband orthogonal codes in a dynamic fashion. SS systems however might not require significant coordination, while trunked systems certainly do. Additionally, SS systems can be resistant to narrowband interference, alleviating some coordination issues. SS systems have also been looked at to provide higher data rates. In such cases, a narrowband emitter is still fairly wide, and would pose perhaps significant coordination issues. Spreading the energy out over a wide number of frequencies should lessen the impact, and might allow easier fitting in of higher data rates to existing amateur bands. Finally, SS systems may prove to be more resistant to multipath problems, however engineering good-performing radio systems with significant multipath is usually a very difficult problem, and SS is not the complete solution.

In the future, there will be additional pressure on spectrum that amateur radio operators occupy. Amateurs have the secondary allocation on many VHF and UHF bands. Fortunately, the primary allocation is, in many cases, to those whose needs are highly compatible with narrowband (amateur) emitters. Unfortunately, this may not always remain the case. Thus SS techniques could prove to be one method whereby amateurs could prove to be compatible with primary users who are susceptible to narrowband interference.

This book should prove to be a valuable source of reference material on these issues, as well as some practical and social ones.

—Tom McDermott, N5EG

Some of the things in this over 200-page book include:

- A Short History of Spread Spectrum
 - Spread Spectrum and the Amateur Radio
 - The Markey/Antheil Spread Spectrum Patent
 - Poisson, Shannon, and the Radio Amateur
 - Primer on Reliability as Applied to Packet Networks
 - An Amateur 900 MHz SS Radio Design
 - Voice Link Over Spread Spectrum Radio - Part 1
 - Voice Link Over Spread Spectrum Radio - Part 2
 - Detection and Estimation of Covert DS/SS Signals using Higher Order Statistical Processing
 - VHF/UHF/Microwave Radio Propagation: A Primer for Digital Experimenters
 - 97.311 SS emission types
 - Wireless LAN/MAN Modem Products
- and much more!

Amateur Radio Spectrum Protection Act Needs Cosponsors

[From the ARRL Pacific Division Update
www.pdarrrl.org]

On March 27, Reps. Michael Bilirakis (R-FL-9th) and Ron Klink (D-PA-4th) introduced HR 3572, the Amateur Radio Spectrum Protection Act of 1998.

The operational portion of the bill is Section 3 (see below), which, if passed, would require the FCC to provide "equivalent replacement spectrum" if the Commission reallocates any primary or secondary Amateur Radio frequencies. You can look up the full text of the bill on the House THOMAS web site at: http://thomas.loc.gov/cgi-bin/query/z?c105:HR_3572

Our strategy is very straightforward - obtain as many House cosponsors as we can before the end of the legislative session and elections later this year. Cosponsors don't vote against their own bills!

Here is Section Three:

SEC. 3. Federal Policy Regarding Reallocation Of Amateur Radio Spectrum.

Section 303 of the Communications Act of 1934 is amended by adding at the end the following new subsection:

- (y) Notwithstanding subsection (c), after July 1, 1998—
- (1) make no reallocation of primary allocations of bands of frequencies of the amateur radio service;
 - (2) not diminish the secondary allocations of bands of frequencies to the amateur radio service; and
 - (3) make no additional allocations within such bands of frequencies that would substantially reduce the utility thereof to the amateur radio service, unless the Commission, at the same time, provides equivalent replacement spectrum to the amateur radio service."

Here is a draft sample letter to send to your Congressperson to enlist him/her as a cosponsor:

The Hon. (congressperson's name)
Longworth House Office Building
Washington, DC 20515

Dear Representative (congressperson's name):

As one of the nation's more than 650,000 licensed radio amateurs, I urge you to sign on as a cosponsor to HR 3572, the Amateur Radio Spectrum Protection Act of 1998.

This bill, introduced by Representatives Bilirakis and Klink on March 27, is a non-partisan, non-controversial measure designed to afford a measure of protection to Amateur Radio frequencies used by radio amateurs in (name

of state) and elsewhere, to provide emergency communication, technical experimentation and recreation.

The bill would require the Federal Communications Commission to provide "equivalent replacement spectrum" in the event it becomes necessary to reallocate radio frequencies currently allocated to the Amateur Service.

This is a matter of fairness, and is in the national interest. The bill would help ensure Amateur Radio's continued public service role to the people of the State of (state name).

Sincerely, (your signature)

FCC Amends Rules For U-NII Devices on 5 GHz

Source: The ARRL Letter
Vol. 17, No. 27

The FCC has amended its rules for Unlicensed National Information Infrastructure (U-NII) devices operating in the 5-GHz range under Part 15 of the Commission's rules. In 1997, the FCC made 5.15 to 5.35 and 5.725 to 5.825 GHz available to U-NII devices under Part 15 of its rules. Amateur Radio shares part of the spectrum involved, which is the in the band 5.650 to 5.925 GHz. U-NII devices would provide short-range, high-speed wireless digital communication.

In response to industry petitions for reconsideration and clarification, the FCC has amended Part 15 to permit fixed, point-to-point U-NII devices in the 5.725 to 5.825 GHz band to operate with up to 1 W maximum transmitter output power and directional antennas of up to 23 dBi gain. The Commission also changed its rules to specify transmit power limits as a function of the channel bandwidth. A logarithmic equation would determine the power permitted. "This action will not increase the maximum power permitted by U-NII devices, but merely scales permissible maximum power to the bandwidth used," the FCC said.

The FCC said it will consider higher gain antennas for U-NII devices for longer-range community networking. In its comments, the NTIA expressed concerns that high-power government radar systems could interfere with the unlicensed devices, but otherwise supported the use of higher-gain antennas for fixed, point-to-point U-NII devices in that band.

The ARRL has argued that longer-range links will interfere with amateur operations and are a significant departure from Part 15, which requires that interference potential of unlicensed devices be subject to "reasonable regulation" so as to not interfere with licensed services. One industry petitioner, Apple Computer, said the ARRL

has not demonstrated that U-NII devices present any real threat of interference to ham operation.

The FCC said it would maintain the power spectral density limits adopted in the original report and order. The FCC also revised its rules to express U-NII out-of-band and spurious emission limits in terms of absolute radiated power levels, regardless of antenna gain.

The FCC advised manufacturers "to consider the proximity and the high power of non-governmental licensed radio stations," including amateur stations, when choosing operating frequencies during the design of their equipment.

The complete text of the FCC Memorandum Opinion and Order is available on the FCC Web page at www.fcc.gov/Bureaus/Engineering_Technology/Orders/1998/fcc98121.txt

APRS Fire Spotter Tracking

Roc Parsons, WSRKN
wsrkn@amsat.org

On 6-27-98 and 6-28-98, we flew an APRS tracker on a CAP (Civil Air Patrol) plane on fire patrol over Central Texas. The extreme fire danger in Texas prompted the Texas Forest Service to request a test of a ham radio tracker to display the spotter plane's positions as well as marking fires on a map that could be projected at the control office at the Austin (Texas) Emergency Operations Center (EOC).

I built a tracker out of parts-on-hand. It consisted of an Alinco DJ-190 5W talkie, a Synergy XTS/II (Motorola ONCORE GT+) GPS receiver and a Mic-Encoder. The tracker was built into an old steel hard disk drive case (about 2x10x10). The 2m antenna was an 8" duck hung from the inside top of the cabin just aft of the rear seat. The GPS antenna was suction-cupped to the rear window. The battery was a 4.5 Amp-Hr gel cell.



The flight plan extended about 200 km west of Austin. We chose to use a voice repeater in Henly (about 50 km west of Austin) to repeat the posits. The EOC monitored the output of the Henly repeater. The Mic-E was initialized in MIM mode to provide "readable" packets. The posit interval was one minute with telemetry (battery voltage and temperature) every five minutes. The tracker was on for 6-1/2 hours without telemetry showing any voltage drop.

The track of the plane was displayed on a large projection screen at the Austin EOC interspersed with still-frame video from the plane when it was close in. Except for two outlying counties, we got good reception of the posits. The altitude of the plane is unknown.

The figure shows a screen capture of the Precision Mapping Window showing the posits received during the exercise. JPEG versions have been uploaded to the TAPR ftp site (FireTrak.zip, FireTrak.txt) and can be found at [ftp://ftp.tapr.org/tapr/SIG/aprssig/files/presentations/](http://ftp.tapr.org/tapr/SIG/aprssig/files/presentations/)

MIR To Deorbit Early: No More Hams In Space

From Newsletter #1091

Live ham radio transmissions from space will disappear a half year earlier than originally thought. This as Russia decides to de-orbit its aging Mir space station next June instead of waiting for the end of 1999.

The decision to decommission the Mir six months early comes amid a mounting financial crisis in Russia. The Russian government simply cannot afford the cost of supporting Mir. They say that deorbiting it next June will save them millions of Rubles.

What this means for Amateur Radio is that an attempt to put some new slow scan television gear on Mir will most likely be turned down by Russian Authorities. More important, there will be no manned ham radio presence in space until the International Space Station is completed and a permanent ham radio station is installed.

According to Frank Bauer, KA3HDO, of the SAREX Working Group, delivery of the first element of the I-S-S Amateur Radio Station is expected about six months from now. When the shipment does go up it will include equipment and services provided by Germany, Russia and the United States.

But the first crew operations is at least a year from now and that date holds only if the timeline for the construction of the I-S-S is held firm. With Russia's monetary problems and its failure to deliver promised I-S-S components on time, that date could easily slip by several months. (Via MIREX, SAREX and published news reports)

TAPR Spread Spectrum STA

The May report was submitted to the FCC regarding renewal of the TAPR STA. As of this time, nothing has been heard back from the FCC with regard to the renewal. Until such time as a cancellation of the STA is offered, then it stays in effect.

The report is available on the TAPR SS Web page (<http://www.tapr.org/ss>)

TAPR Publications

Wireless Digital Communications: Theory and Design

We just sent *Wireless Digital Communications: Theory and Design*, by Tom McDermott, N5EG, into the printer's for a second printing. All the small corrections people had pointed out have been changed for the second printing. An errata page should be up on the web page soon.

TAPR Spread Spectrum Update

The SS Update publication should be available for sale this fall. See the article elsewhere in this issue.

TCP/IP Book

John Ackerman's TCP/IP book inches forward to completion. We are now shooting for a first of the year printing.

1998 CD-ROM

The TAPR 1998 CD-ROM in its third year is finally available. The CD was supposed to have been ready for Dayton, but the CD house we used botched the job big time and now some six weeks after Dayton we are now getting the CDs into the office. For those that ordered the 1998 CD, you should be getting yours in the mail. The CD features

updated information and software on the CD.

The new virtual audio segments on the 1998 CD include:

1997 ARRL and TAPR Digital Communications Conference

Couldn't attend the 1997 DCC outside Baltimore, MD? Then this is your chance to listen to the entire conference. Over 30 hours of audio all together! Plus an entire section of photos taken during the conference!

1997 Open Ham Radio Town Meeting held at Dayton Hamvention

On Saturday, May 17th, 1997, Len Winkler, KB7LPW, hosted the first Open Ham Radio Town Meeting at Dayton Hamvention. Listen in to this fast-paced forum as various individuals face off on: Is the ARRL doing all it can to promote the future of Amateur Radio?

Should contest operators be banned from seeking contacts in parts of the various bands?

Is the Internet killing ham radio?

Should there be a CW requirement for voice operation on the High Frequency bands?

1997 Texas Packet Radio Society Fall Digital Symposium

TPRS held its six annual fall digital symposium in Austin, Texas in December 6th, 1997. You'll see the latest news and information regarding the TexNet, TAPR's FHSS radio project, and other topics. A good meeting.

The CD is in ISO-9660 standard format which will allow it be accessed on any number of platforms. The price is \$20, + \$5 s/h.

1997 CD-ROM

We still have plenty of the 1997 CD-ROM. While some of the software isn't the latest version, the CD still provides audio meetings for

1996 ARRL and TAPR Digital Communications Conference

1996 DCC in Seattle, WA. Over 300 hours of audio all together! Plus an entire section of photos taken during the conference!

1996 Texas Packet Radio Society (TPRS) Digital Forum at Ham-Com

TPRS Digital Forum (held since 1988) is held in conjunction with the Dallas/Ft. Worth HamCom yearly. Presentations include: DXing by Packet, Spread Spectrum an Overview, Exploring the Internet, Beginning Digital Communications, How to use TeXNet, APRS- Radiolocation by Packet, 9600 baud Packet and the NWS, and Accessing the PAC-SATs. Some really good files.

1996 TAPR Digital Forum and Banquet Talks (Dayton Hamvention)

The entire TAPR Digital Forum as well as the Friday night Banquet talk by Phil Kamm, KA9Q. Over three hours of audio all together! The digital forum includes presentations by: Greg Jones, WD5VJD, Barry McLarnon, VE3JP, Phil Kamm, KA9Q, Steve Bihle, N7HPR, Barry Buslow, WA0RJT, Paul Newland, AD7I, and moderator John Aciornamine, AG9V. Topics include: Spread Spectrum, 56K operations, DAS/PCGN, and more! Phil's talk is on "A High-Performance Satellite Mode for the PC."

Bob Bruninga, WB4APR, discusses the APRS Mic Encoder.

Bob Bruninga, WB4APR, uses the APRS Mic Encoder while discussing its usage. The recorded audio was the result of recording the audio from a scanner listening to Bob talk on his 2-meter radio with GPS and APRS Mic Encoder installed. This is an excellent example of the combination of current narrow-band amateur technology with newer digital technology to enhance tracking options.

An interview with Joe Borovetz, WA5VMS, on Land Mobile Radio Modifications.

This is an interview with Joe Borovetz, WA5VMS, concerning Land Mobile Radio Modifications and issues for amateur radio usage. Joe is one of the two authors of the upcoming TAPR Land Mobile Radio Modifications book. Joe covers general information on several radios, minimum test equipment needed, and some general thoughts on the subject at hand.

1995 TAPR Annual Meeting, St. Louis, MO.

Couldn't attend the TAPR meeting in March of 1995? Well - here is your opportunity using RealAudio to listen to

to both the Sunday workshops. The DSP-59 Workshop by Bob Stricklin, N5BRG, and Tom McDermott, N5EG as well as a seminar on Error Control Coding by Phil Klein, KA9Q are made available. Using the Adobe Acrobat format (pdf), we have provided the workshops and between the audio and the overheads you should be able to get a lot from the workshop you couldn't attend!

Repeater Frequency Coordinators Meeting, Oct 7th, 1995

Hear the entire meeting of the nation's repeater frequency coordinators who met with the ARRL and the FCC in St. Charles, Missouri, October 7th, 1995. It was a politically charged meeting that has changed the face of VHF operations forever. This is because there is now a tentative agreement by which the American Radio Relay League has tentatively agreed, subject to board approval, to represent the national coordinators to the FCC. This, in exchange for the coordination recognizing the work of the coordinators and possibly making final decisions binding on the ham radio community.

Packet Radio for the Beginner: 1994 Presentation at Dayton Hamvention

Join TAPR at the 1994 Digital Forum hosted at Dayton each year. This presentation heard Greg Jones, WD5IVD, discuss the aspects of beginning packet radio. Learn the What? Why? and How? about Packet Radio. This approx 30 min audio presentation shouldn't be missed if you are new to Packet Radio.

1982 TAPR Presentation for SLAPR

Listen in on a classic TAPR presentation concerning the TAPR Beta and TNC-1 hold during the first years of the TAPR organization. This talk is by Chuck Green, N0ADI, Lyle Johnson, WA7GKD, and Don Connors, KD2S and was taped in AZ for a presentation that was later shown in St. Louis, MO. A real treat to listen in on the founders of TAPR talk about the new technology and what it might become -- some of it came true -- some didn't. This is a glimpse into the past! If you really feel the need, the QuickTime movie of the presentation is now available on the TAPR CD-ROM -- only \$4 Meg!

Minutes of the TAPR Board of Directors Meeting, May 14, 1998, Dayton Ohio

The meeting began at 5:04 PM. BoD members present were President Greg Jones WD5IVD, Vice President John Ackermann N8UR, Steve Bible N7HPR, PSR Editor Bob Hanson N2GDE, John Koster W9DDD, Barry McLamon VE3JF, Doug McKinney KC3RL, and Mel Whitten K0FFX. Board members not present were Gary Haug N4CHV. TAPR Officers present were Treasurer Jim Neely WA5LHS. TAPR Officers not present were Secretary Steve Stroh N6GNI.

Meeting notes were taken by Doug McKinney, later transcribed by Steve Stroh.

Reports

Due to the absence of Steve Stroh, there was no Secretary's report.

Jim Neely gave the Treasurer's report. Year to date sales are approximately \$66,000. Cash in the bank is \$38,000. \$12,000 is reserved for the next printing of the Wireless Digital Communications - Design and Theory book. \$2,500 is reserved for production of the 1998 TAPR CD-ROM. \$69,000 is tied up in inventory as of March 30, 1998. The corporate tax return will soon be mailed to the IRS- the filing deadline was extended. The Treasurer's report was approved.

Packet Status Register (PSR) Editor Bob Hansen did not have a formal report on the PSR. Instead there was general discussion about the PSR and its role in TAPR. <http://www.tapr.org> is for more time critical events. Steve Bible discussed the value that is placed on receiving the PSR in membership surveys. It's felt that the PSR has value in being delivered to members as reminders. It is possible to use PageMaker for relatively easy Web editions. One issue to be studied is how to get past

issues of PSR onto <http://www.tapr.org>. The ARRL is doing searchable CD-ROM's back to the 1930's. TAPR should discuss with the ARRL how they are creating their archive CD-ROMs, especially how cost effective it is. The next PSR will question the membership on how to do CD-ROM archiving. The Summer 1998 *Packet Status Register* deadline is June 15.

The Membership Report was given. There are a total of 2221 members of TAPR, with 300 International members. There are approximately 25 complimentary memberships. The agenda chart shows a graph of membership. A renewal letter is sent after the last PSR is sent in an expired membership. No print advertisements were used (very low response). Three to five memberships result from the classified advertisements that TAPR runs in various magazines. The classified advertisements were temporarily dropped to see what effect that will have, and will be restarted in June. Suggestions for international advertising were requested. The usual renewal letter hasn't yet been sent so the current membership number is likely artificially low by several hundred. Membership turnover is less than 20%. Writing articles to attract new memberships is important, except those who are doing projects are very busy.

It was discussed on how to get some exposure for TAPR's newer products such as the TAC-2 to non-Amateur Radio magazines such as Scientific American and Circuit Cellar Ink.

The Office Report was given. The new laser printer is MUCH faster. Most orders and communication are being received over the Internet rather than the phone. Some order forms being received are two or three

years old. Handling of the PSR mailing needs to be changed. Dorothy was thanked for her service and she is happy doing the job, especially during DCC and Dayton. The BoD needs to evaluate succession plans for the possibility of Greg Jones leaving and will discuss this issue in depth at the BoD meeting concurrent with the DCC in Chicago in September.

Projects

Project Reports were given. Gross is approximately 5%. Details on top selling products were highlighted on the agenda.

The Original Equipment Manufacturer (OEM) Report was given. There are OEM discussions underway. TAPR is considering doing Type Acceptance of TAPR products to help OEM possibilities.

The Publications Report was given. The second printing of the Wireless Digital Communications, Design and Theory book is ready to go to the printers. One thousand copies will be printed. Amazon.com is being looked at as a possible distribution channel. The 1998 TAPR CD-ROM is in the air to Dayton- it should have arrived by May 12. Jim Wagner's book is missing updates. Updates will be in .PDF format, and readers will have to pay \$3-5 to unlock the files. The TCP/IP book is in finishing. Three parts are done, the last part about gateways and Linux needs updating. The book needs technical review, and it's a user's book. Approximately seven people have offered to look at it. It won't be ready in time for DCC in September, but it will be published by the end of the year. Greg is working on the SS book, but it's not finished yet. TAPR now maintains the AX25 v2.2 specification.

The North American Digital Systems Directory (NADSD) Report was given. Carl Estey, the original NADSD Coordinator has resigned,

Frank Aguilar N5SSH is now the NADSD Coordinator. NADSD is an ideal application for a Web page application.

Project Reports were given. The TAPR Spread Spectrum Radio ("the Radio") has lots left to do- the current estimate is that it will take about two years to complete. The RF section is partially built. The processor board needs lots of work. Tom McDermott is working on the software stack and kernel, and is approximately 2/3 done. Software tasks are drivers, then kernel, then the TCP/IP stack. Tom feels that the Xinu software that he's working with would be a good kernel for future TAPR projects. The Radio project is way under budget- \$7,000 of the original \$10,000 is still left.

The TUC-52 beta kits have been sent, but no responses yet. The Nelson Alpha boards are done. The documentation needs to be completed. Doug McKinney has volunteered to be on the Alpha and Beta tests. The project needs someone to "drive it home" and write something up.

The AN-93 is in Beta Test.

TAC-2 / TOC / DGPS / GPS projects: 250 TAC-2's have been sold. These products brought TAPR recognition from Academic groups and also helps to sell GPS units. The TOC is a daughterboard on the TAC-2. There are two potential markets for the TOC. The first is those that will pay \$500 or more for a TOC- this version has been dubbed "TOC Pro". The second is a group that would prefer a lower cost version, near dubbed (brace yourselves) "TIC", or "TOC Lite". Rick Hamby WB2TNL / CNS has given TAPR the rights to sell CNS' TAC32 software. 25 DGPS kits have been sold. The possibility of offering a case for the Oncore GPS will be investigated. The possibility of

offering the Oncore GT Plus line will be investigated.

Schematic and Printed Circuit Board (PCB) software was discussed. Tango will be investigated for non-profit use (sold through distributors). There may be a recurring cost for maintenance. Steve Bible will talk to Rick Hamby about the Tango issue.

The breadboard of the Replacement 9600 baud modem may be complete by the end of May. The Beta Test would be next. It's felt that the replacement 9600 baud Modem needs to be rolled out in Fall, 1998.

The DSP-93 project is done.

Steve Bible reported on the EVM-56002. It uses a Motorola 56002 DSP. The \$150 EVM is a multipurpose unit. It's a KISS modem. Beta Testers have been selected, and they will be notified within a week. New boards should be received within a week to correct a problem. It's a cheap DSP modem, and source code is readily available.

Nothing has been received regarding an OEM purchase of the 2.4 GHz WaveLAN wireless modems. An order was submitted in February. The distributor isn't responsive, and Lucien assigns the distributor. The reason for offering the WaveLAN unit is to provide the membership with near-term RF solutions. Barry McLarnon will investigate possible solutions and report back to the BoD. Barry, Dwayne Hendricks, and Greg Jones will get together to discuss what to do about the WaveLAN issue.

IDE / Flash Card Interface is still not quite to the point of a proposal being made to the BoD.

Steve Bible discussed future research projects and requested \$500 to purchase a specialized rotor unit. Doug McKinney made a motion to approve \$500 for Steve's research.

Doug's motion was seconded by John Ackermann and the motion was carried.

Officers

Officer Nominations were discussed. Greg Jones was nominated for President, John Ackermann was nominated for Vice-President, Steve Stroh was nominated for Secretary, and Jim Neely was nominated as Treasurer. All nominations were seconded and those nominated were elected.

Old Business

Old Business Report. Greg discussed the current plans and agenda for the DCC. The Memorandum of Understanding (MOU) between the ARRL and TAPR for co-sponsorship of the Amateur Radio Digital Communications Conference (DCC) expires in 1998. The current arrangement is that TAPR runs the conference and the ARRL handles the Proceedings. TAPR is waiting for the ARRL's input. Very preliminary plans are to hold the 2000 DCC in Orlando, FL. Affiliated clubs - no input received from Steve Stroh. The first round proposal with the National Science Foundation (NSF) has been rejected.

A status report on the Spread Spectrum (SS) Rulemaking Proposal was given by Dwayne Hendricks.

The Automatic Position Reporting System (APRS) Digipeater QSY project was discussed. This project was started at the 1997 DCC and has been successful. A fund was created to reimburse expenses incurred in changing digipeater frequencies. The fund consists of \$500 from AMSAT, TAPR, and ARRL. The project should be complete by July.

New Business

New Business Report. Steve Bible made a motion that the policy of funding TAPR Board Members and Officer's travel and lodging to attend meetings be continued. The current policy is that TAPR pays half

of airline fare not to exceed \$200, and half of motel room rate when it's being shared with another Board Member or Officer.

TAPR has unrestricted use of the (now defunct Tetherless Access Limited - TAL) TALnet (NOS++ system) source code. It's planned to sell a TAL router and a radio for \$500. There are sixty S-band radios and 40 L-band radios. There are not enough routers for all the radios. The data rate for the TAL radios is 160 Kbps. It needs to be determined how many radios there are and then sell them to the STA group first and to TAPR members second. Not all of the radios and routers are good, but there are many spare parts.

The BoD decided to file in opposition to the ARRL's position on the Band Plan issue. In general, it's not good for experimenters or TAPR.

The Land Mobile Communications Council (LMCC) has requested that the FCC make Land Mobile communications primary on 420-430 and 440-450 MHz and government and Amateur Radio be made secondary. The LMCC is prepared and ready to fight this out and Amateur Radio is very much unprepared to provide a defense in any significant format or a well reasoned response. Land Mobile has shared spectrum technology, but it's questionable that Amateur Radio would be willing to pay for it. There are 14 days remaining to file, on paper, in response to a 75 page petition. There are several issues - the LMCC filing needs to be put on the Web, Pro/Con points needs to be developed, and then make issues on the points. Dwayne Hendricks will provide comments so the BoD can make a decision and take action.

A raise in the rent for the TAPR Office from \$750 to \$800 was requested. Barry McLamon moved to increase the rent payment to \$900.

Steve Bible seconded the motion, and the motion was carried.

Many thanks to Doug McKinney for taking notes at this meeting.

Respectfully Submitted,

Steve Stroh TAPR Secretary



The Next Generation
TAPR Member

ARRL and TAPR 17th Annual Digital Communications Conference

September 25-27, 1998 • Chicago, Illinois



<http://www.tapr.org/dcc>

Information

Mark your calendar and start making plans to attend the year's premier event in digital communications. The 17th Annual ARRL and TAPR Digital Communications Conference will be held **September 25-27, 1998, in Chicago, Illinois** — just minutes from O'Hare Airport.

The Digital Communications Conference is an international forum for radio amateurs and experts in communications, networking, and related technologies to meet, publish their work, and present new ideas and techniques for discussion. Presenters and attendees will have the opportunity to exchange ideas and learn about recent hardware and software advances, theories, experimental results, and practical applications. If you are doing HF, VHF/UHF, APRS, Spread Spectrum, Digital Voice and Video or other digital communications, then the 1998 ARRL and TAPR Digital Communications Conference is for you. Three seminars/symposiums will be held during the conference and will allow participants to focus on specific topics.

A Conference for the Beginner as well

The conference is not just for the digital expert. This year's conference again provides multiple session tracks for beginning, intermediate, and advanced presentations on selected topics in digital communications. Some of the topics will include APRS, satellite communications, TCP/IP digital radio, Spread Spectrum, and other introductory topics. Come to the conference and hear these topics presented by the experts! Don't miss this opportunity to listen and talk to others in these areas.

Symposia and Seminars

Three symposia/seminars will be held and provides those with additional time and interest to make the most of the DCC. For those who may have interest in just one symposium or seminar, registration for the conference is not required to attend these activities.

The Second APRS National Symposium will be held on Friday and will be moderated by Steve Dinnse, K4HC (the developer of javAPRS). It will likely include many APRS software authors, such as Bob Brunning, WB1APR (the father of APRS), Keith Sproul, W1ZZ, Mark Sproul, KB2ICI (the developers of MacAPRS and WinAPRS), Brent Hildebrand, K1ZZ (the developer of APRSPPLUS), and other nationally-known APRS leaders. Join this group for the afternoon and evening for in-depth discussions and presentations on the current and future status of APRS.

Starting late Friday afternoon, a half-day seminar titled "Infrastructureless Technologies in Amateur Radio," presented by Don Lenke, WB9MIN, will cover the pros and cons of DDMA (directivity division multiple access, a proposed infrastructureless technique) versus hubbed (cellular style) and other infrastructure dependant techniques, the basic problem of megahertz rate communications into the ham QTH, and some techniques for channel-area

Local/International Co-Host

Chicago Amateur Packet Radio Association (CAPRA) is the local co-host and is one of the oldest packet radio groups in the US. CAPRA focuses on education about amateur packet radio, coordination of joint efforts of hams interested in packet radio, and technical and equipment support in the Chicago area. They have had high-speed packet networks operational since the mid-1980s. <http://www.tmaxx.net/capra>

PRUG (Packet Radio User Group of Japan) will be the first International co-host. PRUG will be hosting an informal social Friday evening after the seminar and symposium are completed. <http://www.prug.or.jp>

Call for Papers

Anyone interested in digital communications is invited to submit a paper for publication in the Conference Proceedings. Presentation at the Conference is not required for publication. **Papers are due by August 15th, 1998**, and should be submitted to Mary Weinberg, ARRL, 225 Main Street, Newington, CT 06111 or via the Internet to mweinberg@arrl.org. Information on paper submission guidelines are available on-line (<http://www.tapr.org/dcc>).

Call for Student Papers

ARRL and TAPR especially welcome papers from full time students to compete for the second annual student papers award. Two \$500 travel awards may be given. **Deadline for receipt of finished student paper manuscript: June 20th, 1998.** For full details and paper guidelines contact TAPR or check <http://www.tapr.org/dcc>.

acquisition including full duplex/asynchronous versus simplex/synchronous radio/acquisition concepts.

The Sunday morning seminar will be a combination of two talks. Lyle Johnson, WA7GXD, will focus on the upcoming RUDAK digital communications system scheduled to fly on the AMSAT Phase 3D. Lyle will discuss features, systems design, integration, and experiments. The goal of the presentation is to zero in on the communications capabilities of RUDAK, the performance to be expected, the limitations and capacities of the DSP modems, user requirements for receiving/transmitting to RUDAK, and how amateurs can work to make ground operations a reality. Tim Shepard, KD1KY, regarding "Packet Radio Networks with Millions or Billions of Stations." This talk will present concepts and materials that make you think about different possibilities of networking in the future. Both Lyle's and Tim's presentations focus on different aspects of future digital communications possibilities.

Hotel

Conference presentations, meetings, and seminars will be held at the Holiday Inn Rolling Meadows. Special DCC room rates are \$85 per night. When making reservations with the hotel, be sure to indicate you are attending the ARRL and TAPR DCC in order to get the discount. It is highly recommended that you book your room prior to arriving. A block of 75 rooms is reserved until August 31, 1998. After the 75 rooms are booked, rooms will only be available in nearby hotels, so be sure to book your rooms early! The hotel provides transportation to and from O'Hare Airport. Please contact the hotel to arrange specific transportation needs.

Holiday Inn Rolling Meadows

2405 Algonquin Rd
Rolling Meadows, IL 60008
Phone 847-259-5000, fax 847-259-0597

What can you expect in 1998!

- + A full day of papers and breakout for the beginner to the advanced
- + Three seminars/symposiums
- + The third annual Student Paper session
- + A banquet with Special Guest Speaker Steve Roberts, N4RVE.
- + Informal get-togethers throughout the weekend.
- + TAPR Membership Meeting
- + An event at which the most important new developments in amateur digital communications are announced.
- + Digital 'movers and shakers' from all over the world in attendance.

Conclusion

There are few activities where your participation can be so much fun and important! What a great way to share and renew your enthusiasm for digital amateur radio! A get-together with colleagues and bringing each other up to date on your latest work -- all this, and more, for an unforgettable weekend of amateur radio and digital communications. We hope to see you at the ARRL and TAPR Digital Communications Conference on September, 25-27, 1998!

Full information on the conference and hotel information can be obtained by contacting Tucson Amateur Packet Radio. Phone: (940) 363-XXXX. Fax: (940) 566-2544. Internet: tapr@tapr.org. Web: www.tapr.org

Registration Form

Contact the TAPR office by Phone 940-383-0000, Fax 940-566-2544, or Internet: <http://www.tapr.org> and tapr@tapr.org to register or for additional information.

- * Pre-Registration (before Sept 1st) \$42.00 _____
- * Registration (after Sept 1) or at door \$47.00 _____

Conference Registration includes:

Conference Proceedings, Sessions, Meetings,
and Lunch on Saturday.

- * Saturday Evening Dinner \$20.00 _____
(Limited Space)
Dinner: Steve Roberts, N4RVE Speaker,
Prize Drawing

Workshops (\$15 each)

- * 2nd Annual APRS National Symposium
Friday, 1pm - 8pm \$25.00 _____
- * Infrastructure Technologies in Amateur Radio
Friday, 3pm - 7pm \$15.00 _____
Conducted by Don Lemke, WB9MJN
- * Sunday Seminar Talks,
Lyle Johnson, WA7GXD, Future RUDAK Ops
Tim Shepard, KD1KY, Packet Networks with Millions
or Billions of Stations
Sunday, 8:30am - 2pm \$20.00 _____

TOTAL _____

Name/Cat: _____

Street Address: _____

City/State/Zip: _____

Country: _____ Phone Number: _____

Home Email: _____

Charge my credit card (check one)

VISA MasterCard

Acct # _____

Expiration Date: _____

Signature on card: _____

Mail completed registration form with
check to:

TAPR
8987-309 E Tanque Verde Rd #337
Tucson, Az 85749-9399

or check: <http://www.tapr.org/dcc> for an
on-line registration form.

A registration packet will be mailed in September upon
receipt of registration form and payment.

Kits	Price	Qty	Total	Kit Code	Information
Motorola EVM56002 Interface	\$150.00			14	http://www.tapr.org/taprform/kit56002interface
TAPR APR5™ HIC-Encoder™	\$149.00			28	
TAC-2 (Totally Accurate Clock)	\$139.00			10	Requires a GPS to operate
Differential GPS (Member Price)	\$179.00			14	Requires a GPS to operate
DAS (DTMF Accessory Squelch)	\$68.00			8	As seen in Dec 95 QST
AN-93 I-F Modem	\$90.00			4	Limited kit available.
TAPR 9600 Bps Modem	\$80.00			6	
Bit Regenerator	\$10.00			1	used for regenerative receiver operation
Clock Opalin	\$5.00			1	used for regenerative receiver operation
PK-232 Modem Disconnect	\$20.00			2	simplifies installation of external modems
PK232MBX Installation Kit	\$20.00			2	for installation of 9600 modem to PK-232/MBX
JR2211 DCD Mod.	\$20.00			2	
State Machine DCD Mod.	\$20.00			2	
State Machine DCD w/Intr Clock	\$25.00			2	for PK2 or other TNC-2's (6X or 32K mode)
Firmware					
32K RAM w/ TNC2 update docs	\$20.00			3	
TNC-2 1.1.9 w/KISS EPROM	\$15.00			4	includes 1.1.9 commands booklet, backup
1.1.9 Commands Booklet (only)	\$8.00			2	for TNC-2 command set for 1.1.9
TNC-2 WABDED EPROM	\$12.00			2	8 code/14 pins for AMPS/Dual 10A/11A
TNC-1 WABDED EPROM	\$12.00			2	
TNC-2 KISS EPROM	\$12.00			1	
TNC-1 KISS EPROM	\$12.00			1	
WC-87 WABDED EPROM	\$12.00			1	
Publications					
1998 TAPR CD-ROM	\$20.00			4	500 pages, 850 megs of info w/ many kit pages
1997 TAPR CD-ROM	\$10.00			4	500 pages, 850 megs of info w/ many kit pages
Wireless Digital Communications	\$39.99			0	300+ pages w/disk by Tom McDermott, 14980
Packet Radio: What? Why? How?	\$12.00			3	120 pages. TAPR's Packet Radio book.
IBS Symp Guide	\$9.00			1	60 pages, by Barry Boslow, W4BRJ
NOShops, Intro to RAYO NCS	\$23.00			8	by Vivian GONRV, TCFP over Packet Radio
TAPR's 94 Annual Proceedings	\$7.00			4	Papers from the Annual Meeting (fiction)
TAPR's 95 Annual Proceedings	\$7.00			4	Papers from the Annual Meeting (fiction)
PSR Ser Vol 1 (817 - 817 '82 - '85)	\$20.00			6	
PSR Ser Vol 2 (818 - 816 '86 - '89)	\$20.00			6	
PSR Ser Vol 3 (817 - 812 '90 - '93)	\$20.00			6	
PSR Ser Vol 4 (853 - 848 '94 - '97)	\$35.00			14	
ARRL/TAPR 1997 DCC	15.00			4	1997 DCC Proceedings for home, MD
ARRL CNC Proceedings 1st - 16th	coll				Individual Proceedings call for price
Entire Set ARRL DCC 1st - 16th	\$120.00			144	12 Proceedings from 1981 to 1997
Other					
TAPR 11oz Coffee Mug 1/2oz	\$11.00			4	Logo in black and white on both sides
TAPR Badge	\$10.00			8	white Metal and Color for badge
TAPR Shirt - 4 1/2 oz					http://www.tapr.org/taprform/shirts.html
3 1/2" Disk from TAPR Library	\$3.00			8	\$3 per disk. See TAPR Software Library list
GPS					
TAC-2 Software Registration	\$55.00			8	
Garmin GPS-10 (Member Price)	\$189.00			28	No Discount. (Base price included)
Garmin GPS-25 (Member Price)	\$179.00			28	No Discount. (Base price included)
Garmin GPS-20/25 Interface/Power Kit	\$40.00			8	
Garmin GPS-20R/GPS-25 Data Cable	\$15.00			2	No Discount
Garmin GA-27 GPS Antenna	\$75.00			8	with connector, req. and antenna mount
Oncore VP GPS (Member Price)	\$269.00			28	No Discount
Oncore VP Interface/Power Kit	\$40.00			8	
Oncore GT+ GPS (Member Price)	\$169.00			28	No Discount
Motorola Antenna 97	\$65.00			8	no connector, req. 60004
PKC Ro-Arg Connector w/ coax pigtail	\$15.00			2	No Discount

Subtotal: Added Total Kit Codes

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



Tucson Amateur Packet Radio
 8987-309 E. Tanque Verde Rd #337
 Tucson, Arizona • 85749-9399
 Office: (520) 383-0000 • Fax: (520) 566-2544
 Internet: TAPR@TAPR.ORG • www.tapr.org
 Non-Profit Research and Development Corporation

July 1998

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

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

Renewal New Member

Sub Total

Except were noted

Membership 10% Discount

Member #: _____ (Place new if joining)

Total Sales (Subtotal minus discount)

Texas Residents (7.75% tax)

Membership (New or Renewal)

Shipping and Handling

For Total Kit Codes Between

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

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

TOTAL Order Amount

Charge my bill card (check one)

VISA MasterCard

Acct # _____

Expiration Date: _____

Signature on card: _____

Name / Call: _____

Street Address: _____

City / State / Zip: _____

County: _____ Phone Number: _____

Internet E-mail: _____

