# Activity report of PARNET

Takemi Yamazaki, Masahiro Takeda, Motokazu Kashida,
Masa – aki Yonezawa, and Tadanori Harada

## Abstract

We have been studying and working on digital communications in ham radio for the past year. The group activities are discribed in this paper.

In section one, there are member's profiles, group's aim/policy and results of our investigations. In section two, the hardware of the prototype is described. In section three, the software descriptions and in section four, prospect in the future is written.

## Introduction

Members of PARNET (Packet Amateur Radio Network) are JI1BXM, JA3FGN, JA1MIR, JH1UWU and JE1WAZ. Members are either electronics engineers, or specialists of software and hardware.

### Objectives

We gathered to achieve common goals of the project. Those are:

A)to study the method to connect our transceivers with our personal computers.

B) to establish a computer network through ham radio.

C) to construct a central station for the net – control which has many useful functions with large capacity of memories.

D) to connect our central station to other data networks, JAS- 1 Satellite repeater, AO – 10 and so on.

E) to provide the cental station as an open repeater for world-wide Ham stations.

F) to propose a new packet protocol which fits to the circumstances in JA, and to the mobile radio, if possible.

## Current status

First, several modulation alternatives were investigated, and frequency spectrum was checked by using a computer. And we get the result that the FSK modulated by base- band is good for high baud rate. But it is not easy for a user to reconstruct or to buy a tansceiver for the special purpose. So we made a plan to use the AFSK modulation.

We consider that AX.25 is the standard to connect the worldwide network via a satellite repeater. So we select AX.25 as a protocol to hold a compatibility at the first step, We chose a TAPR-TNC as a compatibility checker and our software is under development through actual data exchange between ours and TAPR's.

On the other hand, we believe that 'easy to make' is important for a hardware. So our hardware is so different from TAPR's and has few tuning point.

We decided that our TNC supports the lower level protocols only. Higher level protocols (level 3 and above) should be handled by personal computers. And the software is designed to be able to change the structure to support yet another protocol which matches the conditions in JA and to the mobile radio in future.

Figure 1 – figure 4 show the result of the calculations of the power spectrum in 1200 baud AFSK modulation. 3 dashed lines in each figure indicates the bandwidth which covers 90%, 95% and 99% of power spectrum, respectively. FIG.3 and 4. show the power spectrum of Bell 202 and MSK respectively.

## Hardware

Design goal of our prototype hardware was to simplify the circuit, to make it a small single board, and to reduce tuning points.

A block diagram is shown in Figure.5 where;

| | | |
|---|---|---|
| CPU: Intel Z80A | CLOCK 2.46 (4.915212) MHz. | |
| RAM: 6116 X3 | 6 K Bytes (including battery backed up RAM 2 KB). | |
| ROM: 2764 X2 | 16 K Bytes. | |

| | |
|---|---|
| SERIAL PORT: 18251 | For VDT or Computer. |
| HDLC CONTROLLER: I8273 | Digital PLL circuit on chip. |
| MODEM: Am7910 | Programable universal MODEM. |
| PTM: 18253 | Genarate baudot rate clock. |

The firmware on ROM controls these LSIs and electrical switches. We planned that the TNC system handles Physical layer and Data Link layer. The Network layer and higher layers are handled by a computer. (See
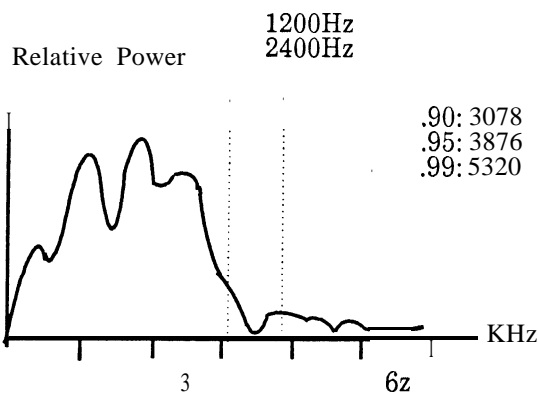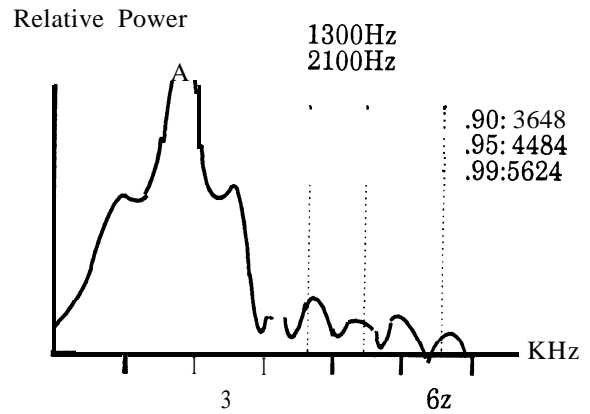
Figure 2 Power Spectrum

Relative Power

1300Hz
2100Hz

.90: 3648
.95: 4484
.99: 5624

KHz

3      6z

Figure 3 Power Spectrum

Relative Power

1200Hz
2200Hz

.90: 3268
.954256
.99: 5510

KHz

3      6z

Figure 4 Power Spectrum

Relative Power

1200Hz
1800Hz

.90: 2508
.953496
.99: 5016

KHz

3      6z

Figure 1 Power Spectrum

Relative Power

1200Hz
2400Hz

.90: 3078
.95: 3876
.99: 5320

KHz

3      6z
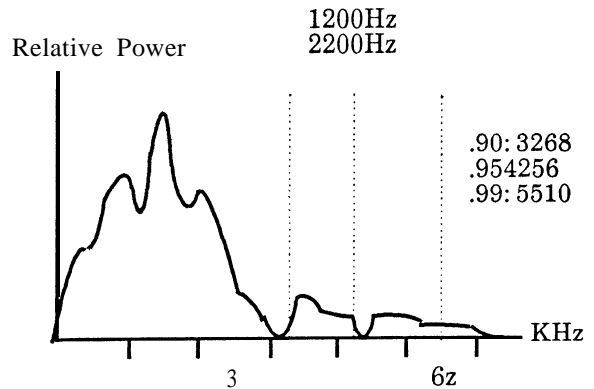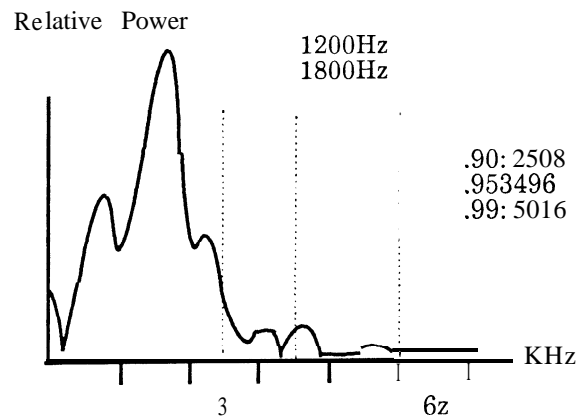
Figure.6) Z-80A processor has enough performance to deal with data and to control the circuit for handling Level 1 and Level 2. RAM area is 6 KB and it is enough to store several packets. Back -up circuit using Ni – cd battery is available to keep parameters set up by a user in static RAMs. SERIAL PORT uses RS-232C standard which is very popular so that the software for interface between the TNC and Computer is simplified. HDLC CONTROL Section is characterized by its Digital Phase Locked Loop (DPLL) circuit . There are hundreds of bits in a packet, so unsynchronized clock causes fatal receiving error. DPLL circuit regenerates clock from receiving data. So it is able to communicate on bit oriented data stream without a clock line. MODEM block is wonderful. There is no tuning point. It generates phase continuous AFSK audio signals, and meets to BELL 103/113/108, BELL 202, CCITT V.21 and CCITT V.23. To meet TAPR TNC, it is programmed to BELL 202.

## Software in PARNET TNC

### Software architecture

TNC has to execute the following jobs simultaneously.

Figure 5 Block diagram of TNC
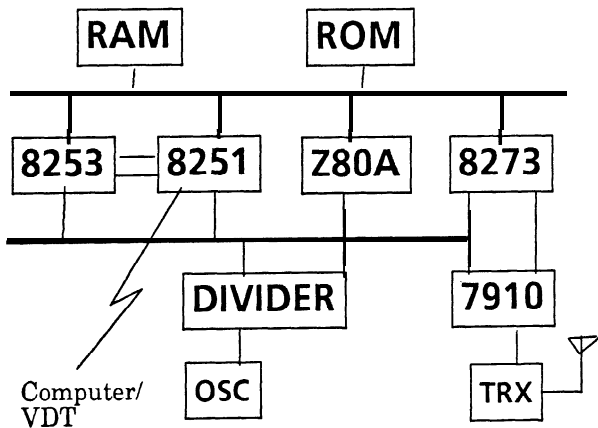
A) Sequence control block: transfers strings (send – data), converses with the terminal, and controls the internal state.
B) Protocol control block: controls the packet header, manages the packet sequence number, and controls the transceiver PTT.

Figure 6 Layer handling

OSI reference model
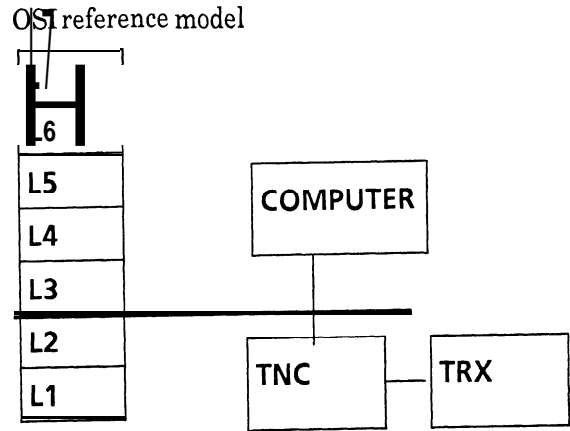
In case of the fact that a single CPU executes more than one task simultaneously, 'REAL TIME MONITOR' are often used as the operating system. But on the development of our TNC, we made the simple language for multi- task execution, not to get down the memory availability, and we use it in order to program the PROTOCOL CONTROL BLOCK.

This language manages the sequence number (label) like BASIC. The control of the routine is always interrupted at the beginning line of the loop, and the control transfer among concurrent procedures is occurred, to avoid possible dead – lock, which causes the violation of the correct sequence control.

The program is converted into language C using a preprocessor which is also written with language C. Since the SEQUENCE CONTROL BLOCK can be programmed just as the main routine, the efficient programming can be expected.

We use an NEC PC -8000 system and C compiler on the CP/M for the development of the software.

### TNC Mode

PARNET TNC has two modes. One is the conversation mode on which we can converse with other pepole by using ASCII characters just like RTTY, and the TNC can be controlled by human readable command. The other is the binary mode where binary files can be

4. 108

transferred. In the binary mode, the conversation and control are achieved by using ESCAPE SEQUENCES, and it is available for a computer to control the internal state sequences.

## Layer assignment

The repeater addresses are set in each packet header and included in the layer $-2$ on AX.25 recommendation. But Japanese authority allows no digipeater at the present time. So the function of the digipeater address specification is not required in JA. Moreover, even if the digipeater was allowed, it should be required that the data flow path information must be allocated in level 3. It is the role of net work layer rather than link layer to control message forwarding. This decision gives us another advantage of realizing shorter packet during the test operation. The reason why we want to reduce the packet length is that the data communication is always (much frequently !!) disturbed by some stupid ham radio guys.

On this layer assignment, the data flow path can be also instructed by any user with a high level algorithm in the host computer.

## Examination in the future

Our major activities, so far, were concentrated on realizing a TNC which is compatible with AX.25. We have completed a TNC which could be utilized to practical use. We are now planing to examine the various applications of the TNC to upper layers and also to look for a method of high-speed transmission, accompanied with good quality.

The items which we are looking at are as follows.

## To design and build a computer for center station.

The idea of the computer is to have the main memory with the capacity of 1 to 2 M Bytes and a hard disc device with more than 20 M Bytes. We would like to use UNIX as OS and release this facility to common users.

## To utilize error correction code

We would like to test the error rate in both with ECC and without ECC statistically, and if the difference is significant, examine the potential of realization of ECC with current TNC. We consider that ECC is necessary to relieve the interference in Japan (ie, jamming). We are looking at the realization by implementing micro-programming and if it is not feasible, we may have to introduce dual processor system.

## To examine modulating methods to enable high-speed transmission

We want to realize the transmission at 12 Kbps to achieve high-efficiency and high-fidelity and implement a low pass filter with a duobinary square-root characteristics to reduce the out-of-band radiation, and the modulator has **4** transmission level. The demodulator will be a discriminator which is compatible with an current FM receiver.