THE **PACKETMASTER PACKET SYSTEM** FOR **CP/M AND DOS** COMPUTERS

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Abstract

This paper outlines the **PacketMaster** system, **a flexible packet program and simple peripheral hardware** to add AX.25 to the repertoire of the personal computer. N.B.: This is much more than a trivial variation on one of the many terminal emulation programs commonly used with external self-contained TNCs. I describe here a true packet peripheral intimately connected with a host computer unlike the typical terminal emulator/tnc combo. In the generic tnc, the tnc is only loosely coupled to the computer (or terminal) usually via a simple RS-232 1200 baud serial line. **The advantages of the peripheral approach over the serial method are the enumerated later in this paper.**

Observations on
First Generation Packet Systems

There has been a great emphasis on the development, manufacture, and use in the amateur community of what are essentially black box appliances--elegantly packaged microcomputers with firmware documented at only the most basic user level. This was acceptable in the early stage of the development of amateur packet radio (only one or two years ago!) when:

a)Users were unsophisticated so just about anything that performed at all was considered adequate.

b)There was minimal freedom of choice: there were only two or three tncs to choose from.

c)There were only hundreds of users dispersed across the United States. So there were no great concentrations of activity anywhere and there were large segments of the country where packet activity was virtually nill.

Second Generation Packet Systems

I propose a second generation of **virtual tncs.** The unifying characteristic of these advanced tncs is that packet capability will be incorporated into true general purpose (gp) computers by simple extensions to their hardware. The major advantage of this integration is that the power of the gp computer can be applied to either the execution of an unmodified packet program or to the permanent modification of it. Not only can extended packet functions be easily accomodated by the host computer but the packet system itself may be readily customized utilizing the resources of the same computer.

The capabilities of current first generation tncs will be extended in second generation tncs. These extensions will be discussed next.

DISPLAY CHARACTERISTICS--

a)The 80 character x 24 line display will become the standard format.

b)Split-screen scrolled operation will be the norm with two independent, approximately equally sized windows for received and transmitted packets, respectively.

c)There should be a command area near the bottom of the screen when in the command mode.

d)There should be a status line at the bottom of the screen to display the time, the current link status, and any other interesting transient activity.

e)If multiple connects are initiated, the windows should automatically subdivide to display maximal information.

f)Screen updates and scrolling will be fast, i.e. they will not be limited by the baud rate of a serial line.

COMMANDS--

a)The command set should be extended and simplified for operation with video displays. The WA8DED firmware for the TNC-1 is a excellent illustration of

what cart be done in th is doma in.

b) The tnc should be optionally under complete computer control. Connects should be accepted and appropriate data logged to disk. There should be an extended, integrated mailbox and message facility. Operational characteristics could be varied and optimized for a particular application by editing a simple command file.

c) There should be onl ine help available at a user selectable level of completeness. i-eve 1 Ø cou ld be expert level with minimal prompt ing; level 3 coulld be defi ned as novi ce level with the quant i ty of help given/available correspondi rigly greater.

PERFORMANCE--

a) The system shoulld utilize a high per-f ormance modems that ut i l i ze stable internal crystal controlled clock generators. A good choice i s the Am79 i0 farni ly of modems. These LSI devices do not not requi r-e either initia3 or period ic ca 1 i brat i cm.

b) Even more exci t i ng l y, these modems may be switched from 1200 baud to 300 baud operation under computer contro1 or manually via a simple toggle switch!

c) Anot her advantage of t h e 7910 family of modems i s that they per f orm well without the necessity of external act ive analog or digital filtering.

USER EXTENSION AND MODIFICATION--

a) Because the appl icat ion code is not effectively hiddert in EPROM arid segments of comment ed source code wi l 1 be made available, the moderately sophist icated user may customize the user interface at will. This is important when a user wishes to handle messages in a specific predef i ned format (such a s an NTS messages). TCP/IP network functions could be included as a true amateur network evolves. Ot her eriv i roments could be created for d i f ferent purposes.

b) The system interface (BIOS) code st i 11 isolates the user from the vagaries of the hardware operation. This we1 l-document ed f irmware should enable the programmer without art electrical engineering background to effectively utilize the packet interface.

Background

The initial goal of this des i gn/development proj ect was to provide a simple, i nexpens i ve means to adapt my Kaypro 10 comput er syst em to packet rad io. The Kaypro is a moderat e performance packaged CP/M system ut i l i zing early-80's technology. It is the latter of a f i ne l i ne of computers start ing with the Ferguson Bi g Board and the Xerox 820 (of p a c k e t rad io fame!), As such, it5 CPU is the Z80 microprocessor arid i t s bus is compat i ble with the Z80 family of peripheral chips. Most import ant 1 y, it contains the Z80 SIO chip. The onboard SIO, when properly init ial ized, is capable of SDLC (i.e., packet) operation with a minimum of external circuitry (the Z80 and SIO combo form the basis of the TAPR TNC2 and i t s many cl ones for those of you who still have doubts about its packet capabi 1 ity).

Why d idn' t I j ust purchase a TNC2 and use the Kaypro as art intelligent termina3? Because!:

a) The TNC2 or one of its many Cl ones was rut yet available when this project was started .

b) I felt (and still feel) that the use of a "real" comput er as a terminal emul at or i s a waste of resources. This is evert more true when the host comput er contains a Z80 and Z80-SIO, the basis of the TNC2. I ask, "Why not j ust buy or build a terminal capable of high baud rate o per-at ion arid standard 80x24 display?".

c) The modem in the TAPR kits uses the superannuated, relatively low-performance 2206/2211 chips; t heref ore, it must be ca 1 i brat ed f requent ly and is susceptible to temperature irtduced drift.

d) The software for the TNC is hidden in proms (firmware), undocument ed, and t heref ore not easi ly modi f ied or extended.

e) The rich CP/M eriv i ronment is not directly available for use in file transfers, split screen displays, arid ex t ended command process i ng and logyi ng.

f) I wanted t o leave open the opt i on to adapt the concepts developed for the Z80 urider CP/M to other processors and operating systems for advanced TNCs and network controllers.

g) The TNC firmware is unembellished. There are no d i agnost ic modes, no help modes, nor i s menu dri vert operat ion avai lable.

A Status Report on the Packet Master System

I have developed and have been running a experimental version of the PacketMaster system for the Xerox 820 and the Kaypro line of computers (hereafter to be known as the PacketMaster-820 and the Packet Master-Kaypro, respectively). The program is of a few thousand lines of modularized Z80 assembly code executing under CP/M. The additional hardware is consists of an external Am7910-based modem and NRZ/NRZI conversicm circuitry. Physically, it is simply a board that connects to one of the serial ports.

The system as it now exists is also compatible with the Ferguson Big Board computer line since the Xerox 820, Kaypro, and Big Board are all closely related. It is probably possible to adapt the system to any CP/M computer with a Z80 and a Z80-SIO connected to allow the use of mode 2 interrupts.

AVAILABILITY of the Packet Master System

If you are interested in increasing the Packet I.Q. of your computer by running the Packet Master system on your CP/M cir DOS computer send a S.A.S.E. business sized envelope to me for current informaticm. Give me at least a cursory descripticm of your computer system so I can determine the applicable information to send you! The externa1 modem board is being layed-out presently (2/86) and should be available soon. Us I describe in the next (final) section of this paper-, I am also working, along with some colleagues, on an IBM-PC packet; interface.

Although the CP/M enviroment was useful and adequate to develop and apply such a packet system, better choices are now available. Namely, the massively popular IBM-PC and its myriad clones and compatibles that run one of the many flavors of DOS is probably the most intelligent choice today. In fact, CP/M is a progenitor of DOS; the other strong influence on DOS is Bell Lab's well-loved UNIX operating system. All the development tools of CP/M (assemblers, librarians, linkers, debuggers) are available under DOS. Their function is generally extended because one of the major limitations of CP/M and the Z80--the 64K addressing limitation of the system is eliminated. More functionality, speed, and intelligence may be built into these programs because of the simple fact that there is up to 10x more space available for them to run on a fully endowed PC! This makes high level language programming a real possibility whenever speed of execution is not a major concern. It is always possible to link high level language routines to assembly language routines that perform time-critical functions. The skillful usage of a structured high level language (example: the C programming language) with reasonable care in commenting results in code that is much easier to comprehend and modify/extend.

The Future: The Packet Master-PC

Therefore, I intend to adapt the PacketMaster concept to DOS machines (the IBM-PC, PC/XT, and its legion of clones and compatibles) after the modem and software have been proven in field test rig using Xerox 820s. The Packet Master-PC will consist of a cheap and simple plug-in board for the PC with an auto-configurable BIOS interface. Of course, the software necessary for a high quality, user friendly interface will be included in the system extending the packet services that are now available under CP/M to DOS. Direct BIOS calls will be available to modify the state of the packet I/O system and to transmit and receive packets for the advanced user.

CONCLUSION

I have briefly related some of my thoughts on second generation micros and the advancements embodied in them. The PacketMaster- and PacketMaster-Kaypro are a reality. And by a somewhat obscure and circuitous route, a flexible packet environment for the IBM-PC will soon be a reality, too!

APPENDIX

description of current
PacketMaster system hardware

7910:
The Am7910 is an LSI modem chip capable of both 300 and 1200 baud operation selectable via 4 input lines to the chip. The dual baud rate option is highly advantageous when shifting between hf operation (where 300 baud is the maximum baud rate allowed) and vhf (where 1200 baud is the norm). Its other major advantage is that is crystal controlled and thus needs no initial calibration or adjustments during normal operation. It is not new to amateur radio-- it is used in the Kantronics Packet Communicator. It's original high price (now dropping) and a fair amount of quirkiness in operation, and just plain inertia may have discouraged the TAPR group from designing it into their products. Once these initial hurdles are overcome the Am7910 proves to be an excellent, high performance choice as the basis for a modem without the requirement of any external active filtering.

description of current
Packet Master system software

pack:
main module-- controls the startup of the Packet Control Program (PCP); contains the main program loop; allows a graceful exit of program back to operating system's CCP (CP/M's console command processor)

paklib:
library module for PCP-- contains six routines necessary for the operation of the PCP

the library routines in paklib are--
dispack:
packet disassembly routine
nrmadd:
receive buffer address normalization routine
asspack:
packet assembly routine
cmdprc:
command processing routine
statex:
routine that uses a state table representation of AX.25 level 2 to determine (re)actions in response to external stimuli. Stimuli may be received packets, commands from the *user*, or timeouts of T1, T2, or T3 as defined in RX.25 protocol documents.
basspack:
auxiliary packet assembly routine