

TheNet X-1J

Overview of Operation

1. INTRODUCTION

This paper introduces the main features of TheNet X-1J. This is an update to the previous paper on version X-1H, and includes a number of changes including the following :

- Support for a simple receive signal deviation meter
- Control over 'slime trailing'
- Info, BText and CText messages may span several lines
- Nodes broadcasts occur 60 seconds after power-up
- An optional 'reconnect to node' following remote disconnect is supported
- PARMS, MODE etc may be changed with offset & new value instead of '* * * 'etc
- Optional control over digi uplink & downlink is supported
- Transport retries (min) has been dropped to 1
- an MTU command has been added to allow easy changes to MTU sizes for IP users
- Information Messages in RAM may be up to 160 bytes long
- The TALK command may be set to pass 8 bit data instead of clearing bit 8
- Node aliases, at the switch, may be made case sensitive

The software is a derivative of TheNet 1.01 by NORD<>LINK. Additional commands and bug fixes have been included in the release. In addition, the Patcher has been upgraded and a bug fix to MOTOROLA.C attributable to KH6ILT has been included.

If your reaction is 'What I really want is', then please read on anyway, especially section 6.

2. STRUCTURE

One of the problems to extending TheNet is the 32 K EPROM limitation imposed by the architecture of TNC2 clones. The solution to this is to implement bankswitching. For the BSX2 TNC and similar TNC2 clones, this can be achieved by the addition of a single wire as detailed in the bankswitch modification file. This is at the expense of the HIGH and LOW commands. The other version that was previously available with HIGH and LOW in it is no longer supported as it is incompatible with the deviation meter.

3. NEW COMMANDS

The following commands have been added to the release

BYE
BBS
HOST
STATS
MHEARD
MODE
MANAGER
AUDIT
TALK

CALIBRATE
LINKS
ACL
CLOSEDOWN
BTEXT
DXCLUSTER
HELP
CTEXT
ALIAS
BBSALIAS
HOSTALIAS
DXCALIAS
QUIT
IPROUTE
ARP
IPSTATS
IPADDRESS
IPBROADCAST
UI
MTU
METER

The following commands have been changed

CQ
NODES
RESET
the <escape> commands
SYSOP

The following features have been added to the code

An Internet Router
Ability to respond to three additional aliases
A CWID keyer
The command processor has been extended
KISS mode operation on the RS232 port
HOST mode support on the RS232 port
Remote configuration of all parameters
Additional textual help messages
Support for a 4 channel ADC used for measuring RX deviation
Other changes as detailed herein.

In addition, a number of small changes have been implemented to satisfy the needs of specialist situations such as the ability to digi beacon packets.

Network management in this context does not just mean 'setting parameters remotely'. It means the ability to set, read and interpret various monitors and diagnostic tools. Version X-1C included the first part of the network management, the MANAGER privilege and the AUDIT process. Version X-1D extends the auditing and statistics significantly including internal CPU monitors. Version X-1E includes most of the additions that are planned, and version 2 will complete the functions. No other release

before version 2 was planned, but the need to produce a version with an IP router has prompted this release. The opportunity to experiment with additional features was therefore taken. The next version was intended to include significant changes attributable to Hayden Bate G8AMD, but again due to other requirements, another interim version has been produced (the main driver being the need locally for the Deviation Meter).

3.1 BYE or QUIT

There are no parameters to these commands. When entered, they terminate the session. Both commands do the same thing.

3.2 BBS

The syntax of the command is :

BBS [* | ? | callsign]

With no parameter, the command connects to a station previously specified by the sysop. Setting the BBS destination is done by the use of the BBS command with a callsign as a second parameter. Setting the BBS to allow this may only be done by a sysop. The '*' option may also only be executed by the sysop, this command clears a previously specified BBS.

The '?' option (or any text if not sysop), prints out the current BBS station setting.

If no BBS is set, the command issues an error message if it is invoked with no other parameters.

The idea of this command is that, like with the 'BBS' command of the 'BPQ software, a user may connect to the local BBS from the node.

3.3 HOST

The syntax of the command is :

HOST [* | ? | callsign]

This command is very similar to the 'BBS' command. It allows connection to a local host, BBS or other server. The difference however, is that as long as the TNC is not in 'crosslink' mode (ie pin 23 on the RS232 port is high), and if a callsign is not set, the 'host' command connects to the local port.

The idea of this command is that, like with the 'BBS' command of the 'BPQ software, a user may connect to the local BBS, another node or server from this node. For example, if a print server were connected to the node in 'host' mode, this command would allow connection to it (like the 'connect' command with no other parameter). In KISS mode, setting a callsign or node alias allows connection to another system.

3.4 STATS

The STATS command has no parameters. It prints a number of internal TNC statistics. In this version, this is limited to the level 1 stats of the radio channel and the internal clocks, the level 2 (AX.25), 3 and 4 statistics, and the CPU health checks.

For level 1, six pairs of numbers are printed, corresponding to the percentage of time the transmitter was on followed by the percentage of time the receiver DCD was on, for each of the last six 10 minute periods. The data is presented most recent period first. Two pairs of numbers are then displayed showing the transmitter underrun and receiver overrun. These are formatted as per the level 2 stats with port 0 followed by port 1 for the current hour followed by the totals for the previous hour. In the case of the RS232 port, underruns are not possible, and an additional error (framing) is included. The RX overrun includes overruns and framing errors.

For level 2, the following are displayed :

- Frame checksum errors
- Total packets heard
- Total packets received by the node (ie sent to it)
- Total packets sent by the node
- Total receiver not ready packets sent
- Total reject packets sent
- Total receiver not ready packets received
- Total reject packets received
- Total number of link timeouts

For each of the level 2 statistics, four numbers are shown. The first two are cumulative totals over the period of one hour, incrementing in real time. The last two are the totals for the previous hour. Each pair of numbers is the total for the radio port followed by the total for the RS232 (crosslink) port.

For checksum errors, port 0 shows CRC errors and port 1 shows (when in 'crosslink' protocol mode only), checksum errors. As HDLC errors can be triggered by noise, acceptance of CRC errors is conditioned by the state of the DCD line. If DCD is on and an error is signalled, it will be added to the count. This reduces the false counts, but does not eliminate them. Distant stations that keep the squelch open (just) without being properly heard will result in lots of apparent errors.

For level 3, the number of level 4 frames gatewayed between nodes is displayed.

For level 4, the number of transport frames sent and received by the node are shown.

For level 3 and 4 statistics, two numbers are shown. The first is the number of frames accumulating for this hour, and the second number is the total number of frames for the previous hour.

For CPU health checking, two statistics are shown, the CPU loading and the buffer usage. Each looks like the level 1 stats with 6 numbers corresponding to the last six 10 minute periods.

The CPU loading shows the number of times, divided by 100, that the CPU makes it around its basic internal scheduler. For a node just switched on, receiving nothing, this will be about 470 ish for a 4.9 MHz clock. With lots of nodes, a heard list of 20 stations and 70-80% activity on the radio channel for it to listen to, this can drop to about 350ish. If it drops to double figures, worry, as the CPU is beginning to thrash. At low double figures, the CPU is pretty much working flatout. Time to up its clock rate !.

The BUFFERS statistic shows the minimum number of free buffers that the software had available to it during the last six 10 minute period. This indicates whether the TNC is failing to deliver data passed to it for onwards transmission, as well as how much data is backed up waiting. Additional stats needed to analyse this properly are not yet being collected.

The display also shows the elapsed time since the last warmstart followed by the running time since the last coldstart. Each number is the number of hours of operation.

3.5 MODE

This command is similar to the PARMS command, and includes the new syntax described in section 3.32.

It allows a number of other features of the software to be configured remotely. It removes the need for most of the host mode <escape> commands.

The following parameters may be configured :

- The host mode
- The CWID send period
- The CWID keyer speed
- The port nodes broadcast control
- The crosslink / kiss control
- The Tx delay
- The full duplex flag
- The RS232 port node broadcast interval
- The node broadcast algorithm
- The beacon period
- The 'connect' redirector
- The 'help message enable' flags, case sensitivity & TALK 8 bit flag
- The 'hash' node broadcast port control
- Whether the node will listen for the extra aliases
- Whether remote disconnect causes reconnection to the switch
- Control over 'slime trails'
- Control over digipeating up/down links

In operation, it behaves just like the PARMS command.

The parameters are as follows :

3.5.1 Host mode control

This parameter controls the 'host' mode. This is the mode of operation of the RS232 port when pin 23 is 'high'

The valid values are 0 or 1.

In mode 0, the port operates as per the standard node specification. Mode 1 is designed to allow connection to hosts or modems or similar equipment that expects a 'CD' type of signal to signify that an incoming / outgoing connection is called for.

In mode 1, the <escape> C and <escape> D commands are disabled and the other <escape> commands do not operate when connected. Instead, hardware handshakes are used to control connections to and from the TNC.

The TNC monitors pin 20 to determine the state of the host, and signals state changes to the host with

pin 5. When an incoming connect request is received (by the 'c' command with no parameters or by the 'host' command), the TNC raises pin 5 to signal the connection and expects pin 20 to change state in response.

When the host wishes to connect to the TNC, it signals on pin 20 and the TNC responds with by changing the state of pin 5.

It handles disconnects in a similar manner. Either the node or the host may initiate disconnects.

This mode is experimental, changes may be made to its operation. It is designed for modems, print servers or hosts such as UNIX system TTY login drivers.

3.5.2 CWID control

The next two parameters control the CWID keyer.

The first parameter is the CWID repeat period in seconds. Valid values are 0 to 3600. 0 disables it but do not set it below 120 apart from to disable it.

The second parameter controls the keyer speed. Specifically, it sets the number of 10 millisecond periods per dot and per inter symbol delay.

The speed of sending is $120/n$, so setting n to 6 gives 20 wpm. Valid values are 4 to 10, corresponding to speeds of 30 and 12 wpm respectively.

3.5.3 Node broadcast control

This parameter allows control to be exercised over which ports nodes broadcasts are sent. Valid settings are 0 - 3.

Value 0 disables node broadcasts. Value 3 (the default) works as normal. A value of 1 enables broadcasts on the HDLC port only whilst a value of 2 enables broadcasts on the crosslink port only.

3.5.4 Crosslink / kiss

This parameter is used to set the communications protocol used on the crosslink port when pin 23 is tied low.

The valid values are 0, 1, 2 or 3

Mode 0 - standard crosslink protocol enabled

Mode 1,2,3 - use KISS instead of crosslink.

In mode 1, KISS simply replaces the crosslink protocol In mode 2, packets received from the radio part that are not intended for the node are copied to the RS232 port in KISS mode. Similarly packets received on the RS232 port that are not intended for the node are sent to the radio port.

In mode 3, all packets received on one port are copied to the other port as well as being analysed by the node.

These modes are not simply KISS implementations that replace the node, they run with the node.

Mode 2 is designed to allow a KISS application and a node to share a radio without interference with each other. The point is that the PC TCP/IP system can be switched off whilst leaving the node running to allow others to use it.

Mode 3 is a debugging mode. One problem when faultfinding on a node is that it is impossible to see what the node is seeing on the channel without replacing the ROM. By setting this mode, it is possible to connect a KISS application to the RS232 port and observe what the node is seeing.

Mode 3 is also designed to allow a PC running AXSTATS to be connected to the RS232 port to allow logging and analysis of channel performance from the node itself. Note that packets initiated by the node for one port will not get copied to the other.

3.5.5 Tx keyup delay

This parameter sets the TX keyup delay in 10's of milliseconds. This was previously done using an escape command.

3.5.6 Full Duplex

This parameter sets or clears the full duplex control flag. This was previously done using an escape command.

3.5.7 RS232 nodes broadcast interval

When a crosslinked TNC is reset, it takes some time to learn about the nodes that the other TNCs can hear. Also, nodes heard by one TNC can take an hour to be notified to the others.

In order to improve this, this parameter may be used to change the frequency of nodes broadcasts on the RS232 port. When set to 0, the node operates as normal. When set to a non zero value, it will broadcast the nodes on the RS232 port at that interval. Hence setting it to 600 would cause nodes broadcasts at 10 minute periods. The nodes broadcasts on the radio port will continue to occur at the basic rate set by the PARMS setting. The obsolescence count will be decremented at the basic rate, not at the faster RS232 rate.

3.5.8 Node broadcast algorithm

This value controls the algorithm used. Bits within the value set have significance as shown below. There is a problem with the nodes broadcast algorithm when many TNCs are crosslinked on RS232. In order to address this a variation to the algorithm has been implemented for experimental purposes. Feedback on its use is requested. Bit zero affects the HDLC port and bit 1 affects the RS232 port. When a bit is set to 1, the node broadcast algorithm is modified so that it will not rebroadcast on the same port a node heard on that port when the best quality neighbour is on that port. It makes little sense to use it on the HDLC port but what the heck, it is implemented for completeness. The only settings therefore that make sense are 0 and 2. These correspond to 'normal' and 'modified on the RS232 port' respectively. Setting it to 1 or 3 will result in some pretty weird effects.

3.5.9 Beacon period

This parameter sets the beacon interval in seconds. In TheNet 1.01, this was fixed at 10 minutes (600 seconds). In this version, this parameter may be used to change it according to the prevailing license conditions.

3.5.10 'Connect' redirector

In TheNet 1.01, when 'connect' is given with no destination callsign, the node attempted to connect to the local host port. In a crosslinked system, this vanished down a black hole. In previous versions of this code, the node attempted to connect to the station set by the HOST command, only trying the local host port if no destination was set by HOST. With this version, the node may be configured to connect to the station set by the BBS, DXCLUSTER or the HOST command depending on this parameter. When zero, connect attempts will go to the HOST station, when set to '1', it will attempt to connect to the BBS callsign. When set to 2 it will attempt to connect to the DXCLUSTER callsign.

3.5.11 'help message enable' flags

This word controls the sending of help messages, with each bit of the word controlling a separate function. Currently, only 6 bits are effective, these being as follows :

| BIT | FUNCTION |
|-----|---|
| 0 | Whether the 'please wait, trying xxxx' operates |
| 1 | Whether all commands appear in help for sysop |
| 2 | Whether the 'goodbye' message is given |
| 3 | Whether a welcome message is enabled (CTEXT) |
| 4 | Whether nodes are shown as 'alias:callsign' |
| 5 | If set, TALK data is passed as 8 bit data rather than clearing the most significant bit |
| 6 | If set, node aliases are deemed to be case sensitive |

When bit 0 is set, and the BBS, HOST or DXcluster commands are given, then a message is sent from the node telling the user that a connect attempt is being made. This does not affect the 'connect' command itself, unless the command is given with no parameter as this is then equivalent of the BBS or HOST command.

When bit 1 is set, and if a sysop gives an incorrect command, the help screen shows all commands possible, including those currently disabled (as by definition they are not disabled for the sysop !).

When bit 2 is set, then the use of the 'bye' command will solicit a 'goodbye' message from the node.

Bit 3 switches on and off the 'CTEXT' message. When enabled, and when a CTEXT message is set, then whenever someone uplinks to the node alias, the ctext message is sent immediately on connect.

Bit 4 switches the way in which nodes are shown when the ROUTES command is used. When set to '1', nodes are shown as 'alias:callsign'. When set to 0, they are shown only as 'callsign'.

Bit 5 controls only the passing of data in TALK mode. Normally, all data sent to the node has its most significant bit cleared, to eliminate parity or similar problems. This is not ideal for those countries that use the extended character set. When this bit is set, and only when in TALK, data is passed as 8 bit data. Note that this does not apply to an initial message sent on the same line as the TALK command.

Bit 6 makes node handing case sensitive. Normally, node aliases are forced to upper case for searching in the table and for user 'connect requests'. If this bit is set, these operations will become case sensitive. This could be very confusing for users unless they are aware of it and expect it. It allows node aliases to

be entered as lower case, for example in setting the node alias and in forcing routes. Don't set this bit unless it is actually needed !.

3.5.12 'hash' node port control

In certain networks (notably the American), there is a need to restrict the propagation of local nodes. This is done by using node aliases that start with a hash character (#) and instructing specific nodes not to broadcast routes to nodes that start with this character. This parameter does this by enabling each port to be individually enabled or disabled in respect to 'hash' node broadcasts. Bit 0 controls the radio port and bit 1 controls the RS232 port. When one of these bits is set, hash nodes will never be broadcast on that port.

3.5.13 Extra aliases

If this is set to '1', then the node will listen for (and accept uplinks to) the aliases set in HOSTALIAS, DXCALIAS and BBSALIAS if they are set. If this parameter is set to '0', or if the respective aliases are not set, it will do nothing. If you do not use the aliases, set it to 0 to avoid wasting processor time.

3.5.14 Reconnect to Switch

If this parameter is set to 0, the node operates as normally. If set to a non zero value (i.e. set to '1'), it operates in 'reconnect' mode. When a station connects to the switch, then uses the BBS, HOST, DXCluster or Connect commands to connect to another station, and then causes that remote station to disconnect them, then they are automatically reconnected to the node with a 'welcome back' message.

3.5.15 NoSlime

This parameter controls 'slime trails'. A 'slime trail' is caused when a remote node, whose identity is not known to the node, sends a transport connect request to the node. Subject to the settings of the port qualities, the node may make an entry in the node table in order to reply to them. Such entries are typified by having no alias associated with them.

Each bit in the NoSlime parameter controls a different function. Bit 0, if set, causes any stations without aliases to be 'hidden' when a nodes command is given. Bit 1, if set, causes the node to refuse to make slime trail entries in the node table. Before you use this feature, be careful to make sure that you understand the implications of doing so, as without fixed entries the node will refuse to accept level 4 connections from a station until it has heard their node broadcast.

3.5.16 NoDigi

This parameter controls the node's willingness to accept digipeated level 2 connections or to allow digipeated downlinks from the node. Each bit of the parameter controls a different function, as shown below :

| BIT | FUNCTION |
|-----|--|
| 0 | If set, do not allow digipeated connections to the node |
| 1 | If set, do not allow digipeated downlinks from the node switch |

3.6 MHEARD

The TNC can be instructed to keep a list of the last 'nn' stations heard, where 'nn' is an integer between 1 and 100. It can also be disabled. The syntax of the command is :

MHEARD [nn]

The parameter is optional and only operates for the sysop. It sets the maximum length of the list. Setting to zero disables the function.

The heard list uses free buffers for the list, so a large setting means less RAM for the node software.

The list is maintained as linked list, with the most recently heard station first. The display shows the number of packets heard from that station and the time since it was last heard, in hours minutes and seconds. In addition, it shows the port on which the station was heard together with an indication as to whether the station is a node and / or a TCP/IP station. It does this by examining the PID byte. Every hour the list is checked for stations that have not been heard for 12 hours, and any such stations are removed from the list.

To disable the internal updating of the list (and thereby stop the CPU expending effort on the function), set the size to zero rather than just disabling the command as described in 3.8. Note though that the node will not clear the list as updates have been disabled, so it will be up to 12 hours before the buffers used are freed. To accelerate this process, set the size to 1, wait until it has heard a station (any one will do) then set it to zero. This will free up all but one buffer immediately.

The heard list is the user interface to the receive deviation meter. Its operation is explained in section 3.31. If enabled (ie if the METER parameter is not set to 0), then an additional column will be displayed in the heard list that will show the received deviation in kilohertz (as nn.n). It must be remembered that this is derived by measuring the received signal audio level, and will not be correct in the case of a badly distorted signal.

3.7 CQ

When CQ is disabled, the command now reports apologetically rather than simply ignoring the request.

3.8 ALL COMMANDS

There is often a requirement to be able to disable the connect command whilst allowing level 3 relaying. This is achieved by the use of a command qualifier, the syntax of which is :

CONNECT [+ | -]

If '-' is entered by the sysop, then the connect command will politely refuse to work. This can be reversed by the '+' command.

This has no effect of layer 3 relaying. Also, the BBS and HOST commands will still allow connections to be made if they are enabled and set.

Further, the syntax is valid for ALL commands, for example the CQ command can also be disabled in the same way. Be careful though. The command is only accepted from the sysop, so if you disable the sysop and manager commands you will lock out remote management !.

3.9 NODES

When information on a node that is not known is requested, the program prints out an error message rather than giving the names of all known nodes.

When a node entry is made by the sysop, callsign checking is forced ON rather than being determined by the callsign checking parameter.

Don't forget that node alias handling may be case sensitive - see section 3.5.11.

The entire contents of the node table routes may be obtained by the sysop or manager by the command

NODES * *

This will dump info on all nodes, one node per line, with the following format:

Alias:call route1 route2 route3

where route1, route2 and route3 comprise the quality, obsolescence count and port followed by the neighbour callsign for each of the 3 route entries for that node. If any of the routes are in use, a chevron will be shown by that route.

The extended command is only for sysop use as it, like auditing and conferencing, causes the node to be a source of a significant amount of data (dumping a large number of node details can consume hundreds of buffers !!!). It is quite possible that used indiscriminately, it could cause a warmstart of the node. Be careful.

3.10 RESET

The syntax of the command is now

RESET [anything-else]

Entering the reset command alone will do a warmstart. If any other parameter is entered, a coldstart is performed.

3.11 MANAGER

The MANAGER command gives the user extra privileges. In this version, this amounts to the ability to receive audit messages from the node. The level of auditing is set by the AUDIT command.

The privilege remains in force until cleared by a command that affects the user state. Specifically, these are, entering the TALK state, executing the SYSOP command, entering the MANAGER command and getting the password wrong, or disconnecting from the node. Failing to get the second password right when using the closedown command will also remove the manager privilege.

If the MANAGER command is executed by a user who connected to the node by a level 4 circuit rather than by a level 2 circuit, and if the level 2 timeout is less than the no activity timeout, the connection will never timeout as the clearing and reconnecting of the level 2 circuit will keep the process alive provided level 2 auditing is enabled. This allows the operation of the node to be logged remotely and continuously. Alternatively, if the level 4 timeout is greater than 10 minutes, level 1 or

CPU auditing will keep it alive if level 2 is switched off. NOTE : I have a nasty feeling that there is something not quite right here - the link sometimes dies !.

A user with MANAGER privilege also has SYSOP privilege.

3.12 AUDIT

The syntax of the audit command is :

AUDIT [new-value]

where new value is an integer value. If no value is given, or the user does not have SYSOP status, the current mask value is displayed. Otherwise, the mask is updated and the new value displayed.

The mask controls the auditing of various events in the node. Not all values are used yet, but those that are, are :

| BIT | USE |
|-----|---|
| 0 | Level 1 statistics on 10 minute updates |
| 1 | Level 2 connects & disconnects |
| 2 | reserved for future use |
| 3 | Level 4 connects & disconnects |
| 4 | Level 7 limited events (use of sysop) |
| 5 | Full level 7 auditing |
| 6 | CPU auditing messages (10 minute updates) |

It is suggested that the usual settings can simply be 0 or 255.

For level 1, messages are sent every 10 minutes showing the percentage of time that the receiver detected carrier and the percentage of time that the transmitter was on.

At level 2 & 4, the messages are of all connects and disconnects, shown in 4 different ways :

- C Connect message received by node
- CA Connect message sent / Acknowledge received
- D Disconnect message received by node
- DA Disconnect message sent / Acknowledge received

In each case, 2 callsigns are shown. At level 2 these are the source and destination of the AX.25 link. At level 4, it is the remote node callsign and user callsign. Each message is preceded by an indication of the source of the message, such as "L2" or "L4".

At level 7, with bit 4 set and bit 5 clear, the only event currently audited is the use of the Sysop command, either directly or via the manager command. If bit 5 is set, then all commands given to the switch are audited, preceded by the callsign of the user who entered the command.

Bit 6 controls CPU health check auditing. If set, then whenever the internal CPU statistics are updated, messages are sent showing the CPU processor loading total and the minimum buffers level (see STATS for more information).

The audit mask value should be set to 0 when not actually being used. Do not leave it set to another value as this wastes processor time. Note also that full auditing on a busy node makes things worse. Treat it as a debugging feature !.

3.13 TALK

Talk is a conferencing command. It allows a number of stations to hold a simultaneous conference (a bit like the CONFERENCE command of a DX cluster). There is only one conference, and stations may connect to it by connecting to the node and issuing the TALK command. It may be exited by disconnecting or issuing the command '/EXIT' at the start of a line. (/EXIT may be abbreviated to /EX, and it is not case sensitive).

Each line sent by a user is copied to all other users in the conference, preceded by the callsign of the user. The data will be sent as 7 bit data (ie the most significant bit will be cleared) unless the appropriate bit is set in the help flags (see section 3.5.11).

Whenever a new station enters the conference, or a station leaves the conference using the '/EXIT' command, the other conference users get a message informing them of the event. These status messages are sent with the callsign of the node rather than the user.

Finally, when entering the TALK command, a message may be sent to all those users who are connected to the node but not otherwise doing anything. For example if GxABC enters the line

TALK Hello fred, can I have a chat, type 'TALK'

Then all other stations connected to the node, present in the USER list but idle, get the message

GxABC>> Hello fred, can I have a chat, type 'TALK'

displayed on their terminal.

Note that merely connecting to the node does not constitute being connected to the switch. Stations connected to the switch appear in the USER list.

3.14 SYSOP

The SYSOP command has been enhanced to increase the level of security offered. One problem of the old system is that the password is easily visible unless the user repeats the SYSOP command a number of times. Even then, correlation between passwords is easy, so the password needs frequent changing. To reduce the change period, and make it harder to discover, the node will accept a string of characters and scan it for the password. Hence a response of, say, 30 or 40 characters can be sent, with a random number of random characters preceding the actual data and a random number following it. This does not eliminate such attacks, but if used carefully, it makes it quite a bit harder to attack.

3.15 LINKS

This command shows the current level 2 links to the node. Displayed one per line, the two callsigns are shown followed by the link state, port number and current retry count.

3.16 CALIBRATE

This command allows remote calibration checks of the transmitter deviation. Its syntax is

CALIBRATE period [toggle]

The period (1 to 60 seconds), is the time for which the transmitter will key up for with constant tone. It is undefined as to which tone will be sent. If the second parameter is given, the node will toggle between the tones every [toggle] seconds. The toggle must be between 1 and [period] seconds. If a period is not given, the user is not sysop or manager, or if it is out of range, the command is ignored. If the tone generator is busy because it is about to send a CWID sequence, a 'busy' message is returned. Note - quite often it can appear that the node has locked up having failed to transmit the full calibrate period. In fact, this is usually the hardware PTT watchdog in the TNC. The node thinks it is still sending but the hardware timer has removed the PTT signal.

3.17 DXCLUSTER

The DXCLUSTER command operates just like the BBS command in that it may be used to effect a connection to a DXcluster (assuming there is one nearby). It should be disabled if it is not intended to be used to access a cluster.

The syntax of the command is :

DXCLUSTER [* | ? | callsign]

With no parameter, the command connects to a station previously specified by the use of the DXCLUSTER command with a callsign as a second parameter. Setting the DXCLUSTER to allow this may only be done by a sysop. The '*' option may also only be executed by the sysop, this command clears a previously specified DXCLUSTER.

The '?' option (or any text if not sysop), prints out the current DXCLUSTER station setting.

If no DXCLUSTER is set, the command issues an error message if it is invoked with no other parameters.

The idea of this command is that, like with the 'bbs' command of the 'BPQ software, a user may connect to the local DXCLUSTER from the node.

3.18 HELP

The HELP command gives a message from the ROM. In general, it is expected that the message will be designed to assist new users in understanding the operation or configuration of the node. The message may span many lines, and may be changed when the ROM is programmed. As delivered, it contains a brief help screen detailing the main (user) changes to the code.

3.19 CTEXT

The CTEXT command sets or displays a message sent to a user who connects to the node by uplinking to the node's alias.

The syntax of the command is :

CTEXT [* | message]

With no parameter, the current message is displayed. If the user is also a sysop, and if text follows the command, that text is added to the current connect text. If the message starts with a '*', the connect text message is deleted. Hence, to clear the message, type the command 'cctext *'. This is a change in version X-1J from previous versions. For further information, see section 3.33

A message is only sent if there is a cctext message set and if the relevant bit is set in the mode command parameter as described in section 3.5.11.

3.20 BTEXT

The BTEXT command sets or displays the additional beacon text sent along with the beacon packets.

The syntax of the command is :

BTEXT [* | message]

With no parameter, the current message is displayed. If the user is also a sysop, and if text follows the command, that text is added to the current beacon text. If the message starts with a '*', the beacon text message is deleted. Hence, to clear the message, type the command 'bctext *'. This is a change in version X-1J from previous versions. For further information, see section 3.33

Normally, beacon packets are UI frames that contain the node callsign and alias. If a beacon message is set, the text of the message follows the alias in the same packet. It is strongly suggested that beacon packets be kept brief !!!.

3.21 ACL

This is probably the most complex additional command in the program. It should be used with care, and only when you really understand its operation - mistakes can result in the need to go out to a remote site (probably when it is cold and wet) to reconfigure the node.

The command allows selective control, based on callsign, of a list of different events. The ACL contains two types of entry, a default value and zero or more callsigns, each of which are associated with a value. When one of the controlled events occurs (such as an incoming level 2 connection or a nodes broadcast), the ACL is scanned for an entry that matches the callsign of the sender. If a match is found (but see below), the value associated with that callsign is used to determine the action the node will take. If no match is found, the default value is used.

Each bit of the value controls a different function, as shown below :

| BIT | OPERATION |
|-----|--|
| 0 | bar incoming level 2 connection |
| 1 | bar outgoing level 2 connection (downlink) |
| 2 | ignore nodes broadcasts from this station |
| 3 | bar gatewaying at level 3 to/from this station |
| 4 | bar incoming level 4 connections |
| 5 | bar outgoing level 4 connections |
| 6 | ignore SSID in matching an entry |

So if for example an entry exists for a callsign G99XXX of 6, then the node will not allow outgoing level 2 connections to the node (downlinks), and will ignore node broadcasts from that station. Note that these commands only operate on the events themselves - if G99XXX creates a level 2 connection, the node will quite happily use it itself.

The 'ignore ssid' bit is used to match a callsign without regard to its SSID. This makes life interesting when finding a match, so the list is scanned twice, once for an exact match, and then for a match ignoring SSID if an exact match is not found. There can only be one exact match, but when searching for a match without using SSID, the first entry found will be used.

The syntax of the command is as follows (3 versions)

ACL * value
ACL callsign + value
ACL callsign -

If you are not sysop, or if ACL is given on its own, the current contents of the ACL are shown. The first form of the command changes the default value, the second form makes an entry in the list, the last form removes an entry from the list. It complains about syntax errors.

A few moments thought will show that the sequence of commands

```
connect to node
execute sysop or manager command
type the command ACL * 127
disconnect
```

is quite catastrophic. You will not be able to get back in again apart from via the host port and noone will be able to connect to or from the node. If you intend to experiment with the command, you should start by entering your own callsign with a value of zero to ensure that you can get back in again !!!.

The list can be used as an 'accept' or 'reject' list by judicious use of the default. To create a list that excludes specific calls, put them into the list with the required bits set in the value. The default should be zero. To create an 'accept' list, put entries in with the required bits zero and set the corresponding bits in the default. Individual bits may be used to create accept or reject lists for each function.

The command steals buffers at a rate of one buffer per four entries in the ACL. Also, a long ACL will slow the node down nicely - so think before you enter a long list.

This command is for experimental purposes - if you find any bugs, let me know please (I have not fully tested the gateway bit for example). Also, it is not intended for malicious use but to allow fine control to be exercised over backbone networks. If I get lots of negative responses back, the command will go !

3.22 CLOSEDOWN

The closedown command is used to shut down the node remotely. If successfully executed, the node will effectively stop operating until it is reset (eg by a power up). The node's configuration (routes, messages etc) are not destroyed - the node simply hits a HALT instruction. You must be sysop to execute the command.

The syntax of the command is:

CLOSEDOWN A

The node will respond with 5 numbers just as for when the sysop or manager command was executed. Yes, you guessed, the node expects another password. Give it correctly and the node closes down completely. Get it wrong and you lose your sysop status. This obtuse and awkward syntax is designed to make sure it is not accidentally executed.

3.23 ALIAS

The ALIAS command allows the node's alias to be changed. The syntax is :

ALIAS [* | new-alias]

If no parameter is given, or if the user is not SYSOP or MANAGER, the current alias is displayed. If the alias is deemed to be a valid alias, the node's alias is changed to the new one entered. Note that the algorithm that checks for the alias structure is a bit queer. It is however, the original algorithm of TheNet and I am loth to change it for fear of side effects. Note too that the companion CALLSIGN command is NOT included - chaos is not something I crave. If the sysop gives the parameter of '*', the node's alias is cleared.

3.24 BBSALIAS HOSTALIAS DXCALIAS

These commands are used to enable the node to respond to up to three additional aliases. The syntax of each is the same, and by way of example the BBSALIAS syntax is :

BBSALIAS [* | new-alias]

If not sysop, if no new alias is specified, or if it does not pass the weird alias syntax checker (see 3.23) then the current alias is displayed. If not, the alias is changed. If '*' is given, the alias is cleared.

The aliases so entered are nothing to do with the node's identity. If a BBS alias is set, for example to MXMBBS, then the node will listen for level 2 connects to that alias. It will respond to them and will automatically invoke the BBS command. The user will also get the optional welcome (ctext) message and 'trying to connect to' messages if enabled by the appropriate 'mode' parameter.

The idea is that where a node sits on a channel that does not have access to the local host, BBS or cluster, the normal aliases of those stations may be enabled in the node to allow consistent access to the local services. Note that the three stations do not have to be a BBS, Host and cluster, it could be three BBSes or any other combination.

3.25 IPSTATS

The IPstats command has the same basic syntax as the PARMS and MODE commands. When invoked without parameters, it displays the current stats. Each statistic may also be altered by sysop, as defined in section 3.32.

In addition to the standard IP MIB, there is an additional parameter used to set the level 2 default modes, and the first entry in the MIB is used to enable or disable the router.

The complete set of IP MIB stats are included for compatibility with other IP systems, but several are

not used. Also, the stats are 16 bit counters not 32 bit counters as in NOS. Like NOS however, the stats do not reset every hour, they must be cleared by the sysop. They will however wrap around at zero.

The entries are:

- 1 Port default modes
- 2 Enable / Disable the IP router functions
- 3 Default IP Time To Live
- 4 IP Received frames
- 5 IP Header Errors
- 6 IP Input Address Errors
- 7 IP Forwarded Datagrams
- 8 IP Unknown Protocols
- 9 IP input frames Discarded
- 10 IP Input frames Delivered
- 11 IP Output Requests
- 12 IP Output Discards
- 13 IP Output No Routes errors
- 14 IP Reassembly Timeout errors
- 15 IP Reassembly Required errors
- 16 IP Reassembly OKs
- 17 IP Reassembly Fails
- 18 IP Fragmentations completed OK
- 19 IP Fragmentation Failures
- 20 IP Fragmentation Creates

The default mode word may be set to 0, 1, 2 or 3. Each bit controls a port, with bit 0 controlling port 0 (radio port) and bit 1 controlling port 1 (RS232 port). When set to 1, the default mode for that port when sending on a level 2 connection will be Datagram. When set to 0 it will be by Virtual Circuit. The default mode is used when no other information is given, either by the ARP table or by the TOS bits in the IP header.

The enable / disable word may be set to 0 or 1. When set to 0, the operation of the router is stopped, when set to 1 the router functions.

The IP Time To Live (TTL) word is used to set the number of routers through which an IP frame may pass before it is discarded. It is similar to the node layer 3 TTL word. It may be set to any value up to 255, but values below 2 make no sense and are therefore not permitted.

The IP fragmentation reassembly timeout counter is not used as the node is just a router. It is left set to 30 seconds just to show which one it is !

The rest are just statistics. The patient user can have hours of fun working out which ones are not used (or just think about it for a second or two).

3.26 IPADDRESS & IPBROADCAST

These commands are used to set or display the IP addresses used by the node. The syntax of each is (by way of example):

IPADDRESS [ipaddress]

where ipaddress is in the form

nnn.nnn.nnn.nnn

where nnn is an integer in the range 0..255

So to set the node IP broadcast address to that used over here, the command would be :

IPBROADCAST 44.131.0.0

The IPADDRESS is the address that the node will respond to. It is used only as detailed in section 7. The IP broadcast address is the one used to denote broadcast packets that will be largely ignored. Note that port addressing is NOT currently supported. Anyone who finds this limiting, drop me a line and I'll see if I can change it.

3.27 IPROUTE

This is one of the two main databases used by the node. The IP Route table is used to tell the router where to send a frame for a specific destination. It maps addresses or address ranges to a gateway IP address and to sub-network ports. The ARP database then tells the node what station corresponds to that address and protocol. The node supports two subnet protocols, AX25 and Net/Rom.

The database is stored in an ordered list, in decreasing order of the number of relevant bits. This is to permit searching of the database when trying to find a specific destination. Given an address, it scans addresses with decreasing numbers of bits until it finds a match. The syntax of the command is as follows :

IPROUTE [address [/ bits][+ port [gateway [metric]]]]

or

IPROUTE [address [/ bits][-]]

In the first form, it makes an entry in the table, in the second it deletes one. Only sysop or manager may effect such a change. The parameters are as follows :

| | |
|---------|---|
| address | The amprnet address in the form nnn.nnn.nnn.nnn |
| bits | The number of significant bits (eg 44.131.0.0 / 16) |
| port | The port, either 0 or 1 for AX25 or n for Net/Rom |
| gateway | The optional gateway for this dest. nnn.nnn.nnn.nnn |
| metric | Currently not used, a numeric value |

When an entry is made with a specific number of bits, the address is 'masked off' to that many bits, so enter an address of 44.131.16.31 / 24 and it will get entered as 44.131.16.0. The valid range for the number of bits is 1 - 32.

3.28 ARP

The ARP table maps a pair of address+port to hardware address+subnetwork mode. The address is

either a destination or a gateway in the form nnn.nnn.nnn.nnn. The protocol is either Net/Rom or ax25. The hardware_address is a callsign and the subnetwork mode is DG or VC (only has significance for level 2 links).

The syntax of the command is :

ARP [destination [+ [P] protocol callsign [mode]]]

or

ARP [destination [- protocol]]

In the first form an entry is made in the table, in the second an entry is deleted. This is only permitted for sysop or manager.

The parameters are :

| | |
|-------------|--|
| destination | An address of the form nnn.nnn.nnn.nnn |
| P | If present, marks the entry as 'published' |
| protocol | AX25 or Net/Rom |
| callsign | A valid amateur callsign, e.g. G8KBB-5 |
| mode | DG or VC |

If 'P' is entered, then the node will publish the address. Specifically, if an ARP request is seen by the node for a station with the address given, it will send a response advising the caller of the callsign to be used.

More details on the operation of the router are contained in section 7.

3.29 UI

The UI command allows a string to be sent as a Level 2 UI frame. The syntax is

UI dest string_of_text_ending_in_return

Dest is a callsign like destination such as 'MAIL'. What will happen is that a single UI frame will be sent with a source callsign of the user who entered the command, a destination callsign of dest, and the rest of the string as text.

It is designed to be used in situations where a local BBS does not have access to a common channel and wishes to send mail notification packets. Not surprisingly, the ability to do this is BBS specific.

3.30 MTU command

The MTU command is used to configure the node's Maximum Transmission Unit figures (primarily for TCP/IP support). In general, they should be left at the default values. Do not experiment unless you are sure you understand the significance of what you are doing !!!!

The syntax of the command is identical to the syntax of the PARMS and MODE commands, as defined in section 3.32.

There are 5 values configured by the command. These are :

| Number | Default | Function |
|--------|---------|---|
| 1 | 256 | Sets the MTU for the IP router, AX.25 Level 2, Radio port (port 0) |
| 2 | 256 | Sets the MTU for the IP router, AX.25 Level 2, RS232 port (port 1) |
| 3 | 236 | Sets the MTU for the IP router Net/Rom interface |
| 4 | 257 | Sets the maximum number of data bytes permitted in an AX.25 level 2 frame before an error response is returned to the sender (frame too long) |
| 5 | 328 | Sets the maximum number of bytes permitted in a level 2 packet. Above this, frames are discarded. If a packet may contain 256 data bytes, and a maximum length address of sender, recipient and 8 digis comprises 70 bytes, and 2 bytes are used for control bits, the total (256+70+2) is the setting of this parameter. |

This command replaces the ROM patching needed for TheNet X-1H.

The minimum that an MTU may be set to is 64, the maximum is 1024, but large packets increase the probability of crashing the node. Beware !!!!!.

The MTU for the Net/Rom port should not in general be set higher than 236 or it will not be compatible with Net/Rom.

The limits on the other two correspond to those necessary to support frames in the range 256 - 1024 data bytes long.

3.31 METER command

The Meter command is used to control the ADC functions of the software. In this version, this is limited to the Deviation meter, but future releases may extend this, for example to configure a signal level meter.

The syntax is as for the PARMS and MODE commands, as defined in section 3.32. It currently has only one parameter.

When set to 0, the deviation meter is disabled.

When set to a value in the range 1 - 255, the meter is enabled and the value is used as a scaling factor. The ADC is an 8 bit device, so it will give a response in the range 0 - 255, corresponding to an ADC input voltage in the range 0 - 3 volts DC. If optimally configured, this corresponds to the maximum audio level possible for the given receiver discriminator.

The ADC reading (0 - 255) is multiplied by the meter parameter value (1 - 255) to give an answer in the range 0 to 65 KHz (approx). This is the value displayed in the mheard list.

Hence, if, for example, a DC voltage of 2 volts at the input to the ADC corresponds to 3.4 KHz deviation, the ADC reading will be 171 (+- a few) and the Meter parameter will need setting to 20 (ie to 3400 / 171).

If the ADC reading is 254 or higher, then in order to indicate an overrange, the symbol '>' will precede the corresponding deviation entry in the heard list.

3.32 PARM, MODE, MTU, METER & IPSTATS command syntax

The syntax of these commands has changed.

All use the same syntax, which may be either of two types, the original TheNet 1.01 syntax (as used in versions previous to X-1J) or an 'offset & value' type.

The original syntax was, by way of example,

```
PARM { [ * | new_value ] [ * | new_value ] ..... }
```

so to set the 10th PARM (the L4 retries) to 1, the syntax would be :

```
PARM * * * * * 1
```

The equivalent new syntax command would be :

```
PARM / 10 1
```

The '/' command signifies that what follows is the parameter number followed by the new value. As for the old command syntax, the complete list of parameters is displayed. Setting the parameters may only be done by a Sysop. Note that BOTH command syntaxes are supported - you can use whichever you prefer.

3.33 BTEXT, INFO and CTEXT Command Syntax

In Version X-1J, the syntax of these commands changed. In addition, the Info message was doubled in size to 160 bytes.

If someone who is not Sysop uses the command, the current settings are displayed.

If a Sysop uses it without any additional parameters, the current setting is displayed.

If a Sysop enters one of the commands followed by a parameter of '*', the current message is deleted.

If a Sysop enters a string of text, that text is added to the current message, followed by a newline.

It is therefore possible to build up multiple line messages. If you wish to start a message with a blank line, enter a message with a non display (or innocuous display) character such as control-A. It will get entered followed by a newline. On most systems this will not display. On some systems such as PCs running NOS, it will display as a smiley face.

4. Other Changes

This section covers the other miscellaneous changes to the software.

4.1 Command Processor

The command processor has been altered. In general, but not in all cases, commands only appear on the 'help' menu when they are enabled, so for example the 'BBS' command will not be shown unless it has been enabled with the 'BBS +' command. The exception is the sysop commands, like MODE, LINKS and PARMS, which are never shown to users but are of interest to them. If the appropriate bit is set however in the MODE command (see 3.5.11), then for the sysop or manager, all commands appear in the help prompt - EVEN IF DISABLED.

The help screen now shows commands in a combination of upper and lower case characters.

4.2 Beacon digi

It is possible to set a digi in the address used for beacon packets. Details of how to do this are contained in the configuration guide. Note that this is provided for those rare occasions when there is a genuine need. This is rarely the case and should not be done unless really necessary.

4.3 Nodes Broadcasts after power-up

The node will now broadcast its node table 60 seconds after power-up. This is to ensure that the network is back to an operational state as soon as possible following a node reset. The reason for the short delay is to cater for the situation where the Sysop switches on the node before the radio.

5. CWID keyer.

The CWID keyer sends the station callsign in CW by alternating between the two modem tones. This is nominally sent at 20 wpm once every 30 minutes, but the speed and period can be changed remotely.

After a delay of 30 minutes, the callsign is sent appended to the end of the next data packet that is sent over the air. There is a 500 ms delay after the end of the data packet before the call is sent.

The program prefers to send CWIDs appended to ordinary data packets. However, if one minute after the CWID has supposed to be sent it is still pending because no data packets have been sent, it will key up the transmitter anyway. Persist, TxDelay and other parameters are honored, but the process involves changing the SIO mode and this will have an annoying effect on any packets being received in full duplex mode.

6. Version X-2.

X-1 was the first release of this code. The objective is to get some practical feedback and test the code before the full release, version X-2, which I hope will be very similar to this release (X-1J). I have been saying this for some time now, but things keep getting added. The next version will hopefully be a significant change with extensions from G8AMD, but this may be some time off yet...

Version X-1A added the escape-N command and the change to the connect, nodes and reset commands. The timers were also added to the stats command.

Version X-1B removed all the escape commands apart from C,D and P. It also added the MODE command and extended the + and - command qualifiers to all commands.

Version X-1C added TALK, MANAGER and AUDIT. The SYSOP command was enhanced and the INFO command was altered to limit the length of a message (a bug in the original version of TheNet). The help screen was changed to display commands in a combination of upper and lower case.

Version X-1D extended the auditing and statistics to cover auditing everything but level 3, and statistics of the CPU, Level 1, Level 2 and timers.

Version X-1E added beacon timer control, the connect redirector, the nodes dump facility, level 3 & 4

statistics and the LINKS and CALIBRATE commands.

Version X-1F added the CLOSEDOWN, DXCLUSTER, ACL, CTEXT, HELP and BTEXT commands. Another parameter was added to the MODE command to control textual messages. The mod suggested by DF2AU to correct the DCD latchup was included. Additional statistics were added covering CRC errors, receiver overrun, transmitter underrun and framing errors.

Version X-1G added mainly the IP router, with the following commands to control it - IPRROUTE, ARP, IPSTATS, IPADDRESS, IPBROADCAST. In addition, the ALIAS, BBSALIAS, HOSTALIAS and DXCALIAS commands crept in, as did QUIT as an alternative to BYE. The help messages extended to enable nodes in the routes list to appear as alias:callsign, and an extra byte on the MODE command allowed '#' nodes to be selectively NOT broadcast. The order of HELP and HOST commands changed so that 'h' on its own gave help not host. The code was optimised with some time critical parts being recoded in assembler and a peephole optimiser being used for additional improvements.

Version X-1H fixed 3 bugs in X-1G.

Version X-1J added the deviation meter support with the Meter command and Mheard changes. In addition, parameters were added to the MODE command for slime trail control, control of digipeating and reconnection to node. The command syntax of Info, Btext and Ctext was changed to support multiple lines and the Info message space was doubled to 160 bytes. Nodes broadcasts now occur 60 seconds after power up and the ARP Digi bug fix was included. The level 4 minimum retries was dropped to 1 and the PARM, MODE, IPSTATS, METER and MTU command syntax was extended to support 'offset & value' type operation. An MTU command was added to allow IP MTU limits to be changed under software control. The node alias case sensitivity bit and TALK 8 bit data bits were added.

If you read this and say 'Pah. it doesn't do XXXXX' or 'It still doesn't do YYYYYY' or anything of a similar nature, don't keep it to yourself. Tell me. I may well do it. An example of this are the many changes introduced into X1-J as a result of suggestions mainly by KA2DEW.

7. The IP router

The IP router co-exists in the node with the other software. It is connected to the L2 and L3(Net/Rom) protocol machines, and is managed from the L7 switch. It will accept data from L2 Datagrams, L2 Virtual Circuits or NOS protocol extended Net/Rom frames. It will output to these 3 depending on the setting of the IProute and ARP tables.

The router supports the IP options of NOS and also does IP fragmentation. Level 2 segmentation is not supported. In addition, ICMP is implemented in so far as it is needed to respond to errors or PINGs. No higher layer support is provided, i.e. TCP is not implemented, ip_send() and ip_receive() are only implemented in so far as they are needed for ICMP. You can therefore PING it but anything else will solicit an ICMP error message.

It will respond to ARP & REV_ARP requests but will never initiate them. The default MTU is 256 for AX.25 and 236 for Net/Rom. It will accept longer datagrams than this and fragment the output but it is not recommended as it merely wastes RAM. The MTU command may be used to change this.

It is possible to be creative in the use of L2 datagram and virtual circuits by use of the port default settings and the ARP table. The algorithm used is :

When a frame is to be sent, the ARP table is scanned for the appropriate entry. The entry tells

it what callsign to use. For Net/Rom encapsulation, it is send to the Net/Rom protocol handler. For AX.25 encapsulation the following applies. The ARP table may indicate DG or VC. In this case, that mode is taken. If there is no DG or VC entry, the TOS bits are examined. If the delay bit is set, a datagram mode is selected. If not, and the reliability bit is set a virtual circuit is selected. If neither bit is set, the default mode for that port is used to select a mode (see IPstats command, first parameter).

Port addressing is not supported at the moment.

The IP router is manually controlled - no rspf or rip, or even ARP requests. This is because 32K of RAM does not allow such niceties as queuing frames whilst waiting for address resolution.

8. MISC

Anyone interested in a copy of the program, drop me a message on GB7MXM.#36.GBR.EU Also, any suggestions for change gratefully received.

Dave G8KBB
7, Rowanhayes Close
Ipswich
IP2 9SX
England