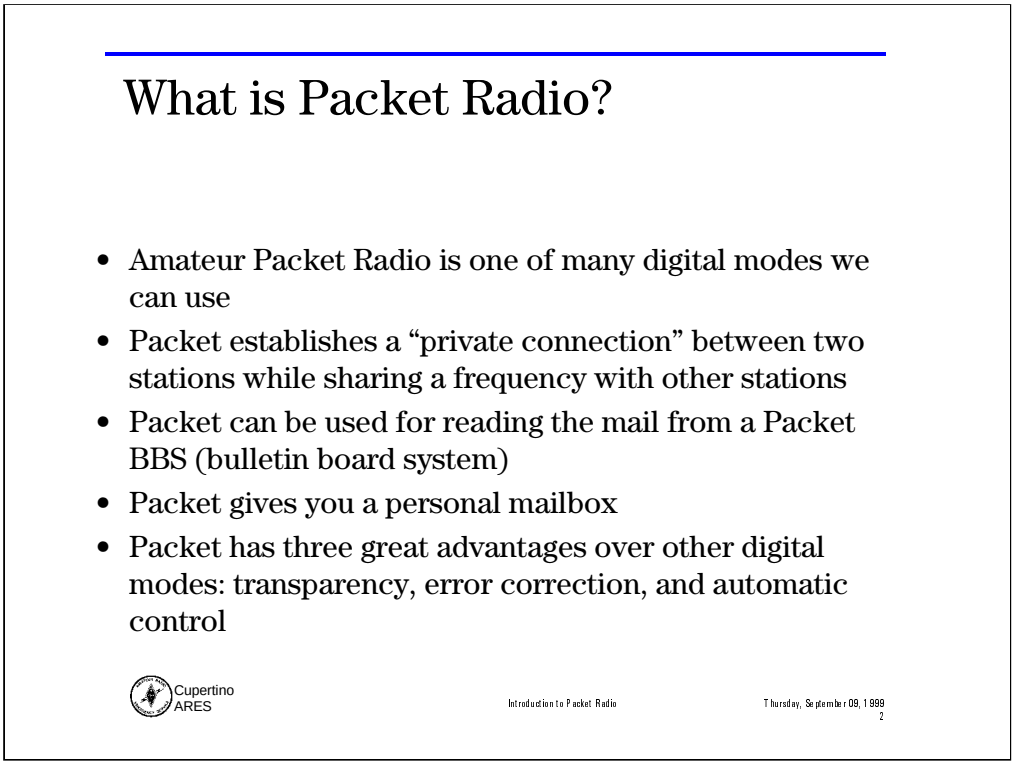
Cupertino Amateur Radio Emergency Service
September 9, 1999

Introduction to Packet Radio



Notes

The operation of a packet station is transparent to the end user; connect to the other station, type in your message, and it is sent automatically. The Terminal Node Controller (TNC) automatically divides the message into packets, keys the transmitter, and then sends the packets.

While receiving packets, the TNC automatically decodes, checks for errors, and displays the received messages. Packet radio provides error free communications because of built-in error detection schemes. If a packet is received, it is checked for errors and will be displayed only if it is correct. In addition, any packet TNC can be used as a packet relay station, sometimes called a digipeater. This allows for greater range by stringing several packet stations together.

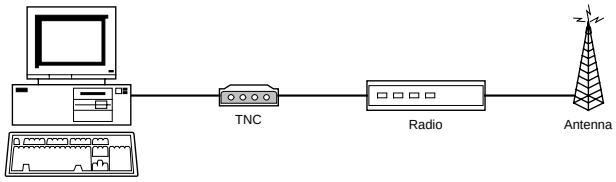
Users can connect to their friends' TNCs at any time they wish, to see if they are at home. Some TNCs even have Personal BBSs (sometimes called mailboxes) so other amateurs can leave messages for them when they are not at home. Another advantage of packet over other modes is the ability for many users to be able to use the same frequency channel simultaneously.

RACES/ARES/NTS and Emergency Communications

Packet radio is being used in many emergency services. Whether packet is used to pass a message accurately and in large quantities or to handle messages passed by the National Traffic System, it can provide an important function like any other amateur mode when used correctly.

In Santa Clara County, Packet Radio will be used to back up RIMS, the State's primary digital communications system, for passing traffic between City EOCs and the County EOC.

Components of a Packet Station



- Computer - runs a "terminal emulation" program
- TNC - Terminal Node Controller; similar to a modem, the interface between your radio and your computer
- Radio - with antenna, transmits the digital data from the TNC to another packet station
- Various interconnecting cables and power supplies

Notes

Computer or Terminal

This is the user interface. A computer running a terminal emulator program, a packet-specific program, or just a dumb terminal can be used.

TNC (terminal Node Controller)

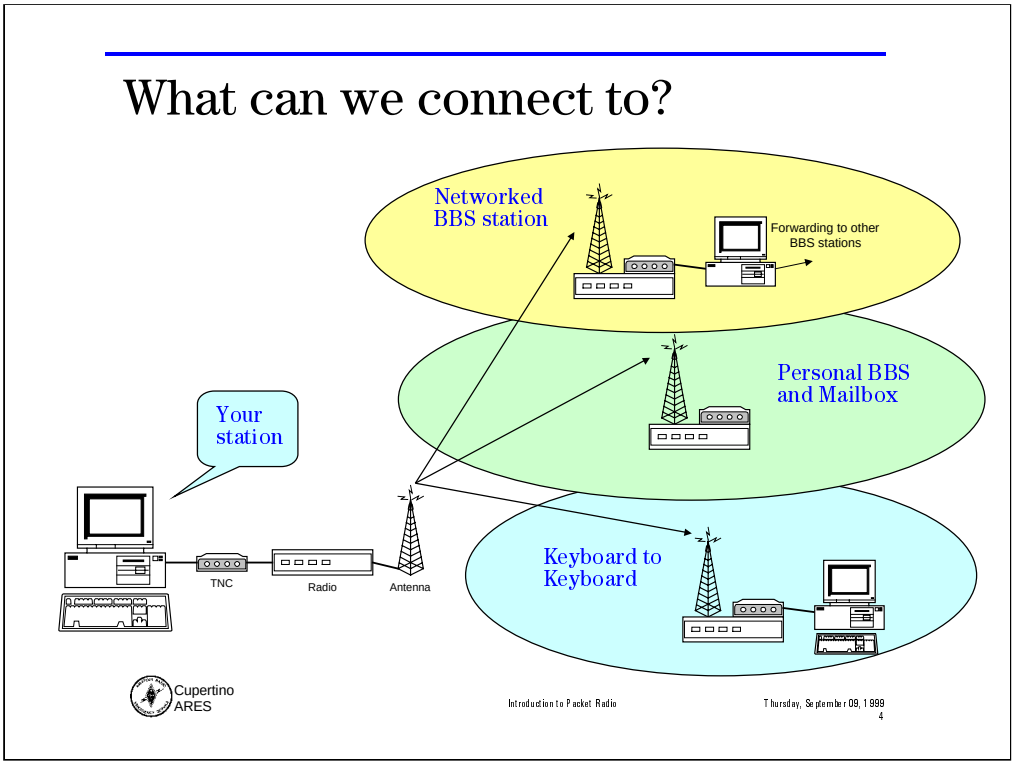
A TNC contains a modem, a computer processor (CPU), and the associated circuitry required to convert communications between your computer (RS-232) and the packet radio protocol in use. A TNC assembles a packet from data received from the computer, computes an error check (CRC) for the packet, modulates it into audio frequencies, and puts out appropriate signals to transmit the packet over the connected radio. It also reverses the process, translating the audio that the connected radio receives into a byte stream that is then sent to the computer.

Most amateurs currently use 1200 bps (bits per second) for local VHF and UHF packet, and 300 bps for longer distance, lower bandwidth HF communication. Higher speeds are available for use in the VHF, UHF, and especially microwave region, but they often require special (not plug-and-play) hardware and drivers.

Radio

For 1200/2400 bps UHF/VHF packet, commonly available narrow band FM voice radios are used. For HF packet, 300 BPS data is used over single side band (SSB) modulation. For high speed packet (starting at 9600 bps), special radios or modified FM radios must be used. 1200 bps AFSK TNCs used on 2-meters (144-148Mhz) is the most commonly found packet radio.

Ref: Tucson Amateur Packet Radio homepage



Notes

Packet Bulletin Board Systems (BBS)

Most cities have one or more packet Bulletin Board Systems, or BBS for short. BBSs do two main things: send and receive personal messages for their local users (like yourself) and send and receive messages or bulletins intended for people locally or around the world. Since the BBS is part of a national system of other BBSs, it has the ability to pass information or messages to any other BBS in the US or the world. This allows you to send messages to friends locally, to someone located in the next state, or to someone on the other side of the world. The second thing that BBSs do is pass local and national bulletins, which are messages intended to be read by everyone. In this way, amateurs can read the latest messages about the ARRL, AMSAT, TAPR, propagation, DX, and other bulletins on varied topics.

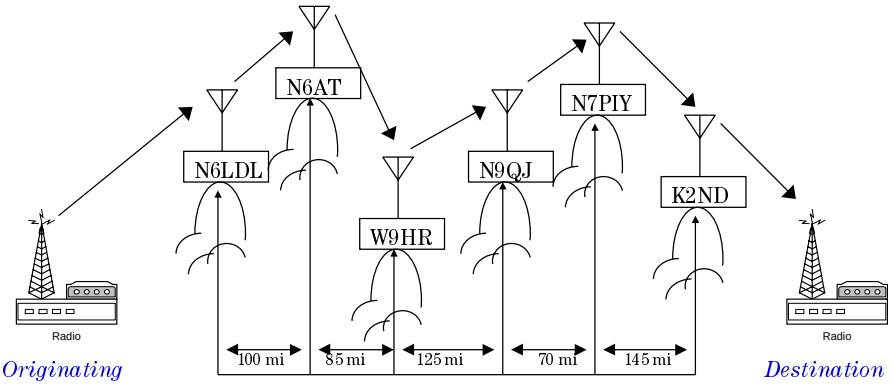
Keyboard-to-Keyboard

Like other amateur modes (SSB, FM, etc), packet radio can be used to talk to other amateurs directly. Amateurs can talk to each other simultaneously using their keyboards when they can directly communicate with each other. Keyboard-to-keyboard communications is one of the least frequent methods of packet communications, because amateurs are rarely on packet at the same time. Many packet operators send electronic mail using either personal mailboxes or a local BBS. In this way, messages are read when the amateur is on the air. Another limitation to direct keyboard-to-keyboard packet is that you can only talk to one packet station at a time, no easy way to hold round-table discussions like on a voice repeater.

Ref: Tucson Amateur Packet Radio homepage

Networked BBS Stations

passing a message from station to station



Cupertino ARES

Introduction to Packet Radio

Thursday, September 09, 1999

5

Notes

Some 2 meter packet frequencies

… and local stations of interest

Freq (MHz)	"organized" stations or use
144.910	N6HDN-6 (County EOC)
144.930	N0ARY-1 (networked BBS station)
144.950	
144.970	N6LDL (networked BBS station)
144.990	
145.010	
145.030	
144.050	K6FB-2 (club BBS)
145.750	tcp/ip on packet
146.595	N6ST (DX spotter network)

Notes

TNC vs BBS Commands

TNC Commands

Some of the commands that control the TNC

- MYCALL - sets the TNC call sign
- HELP, ? - displays available commands and usage
- CONNECT - connects to another TNC

Other useful TNC commands

- MONITOR - turns on or off frequency monitoring
- RESET - re-initializes the TNC to the power-on state
- CONVERSE - force the TNC into "connected" mode

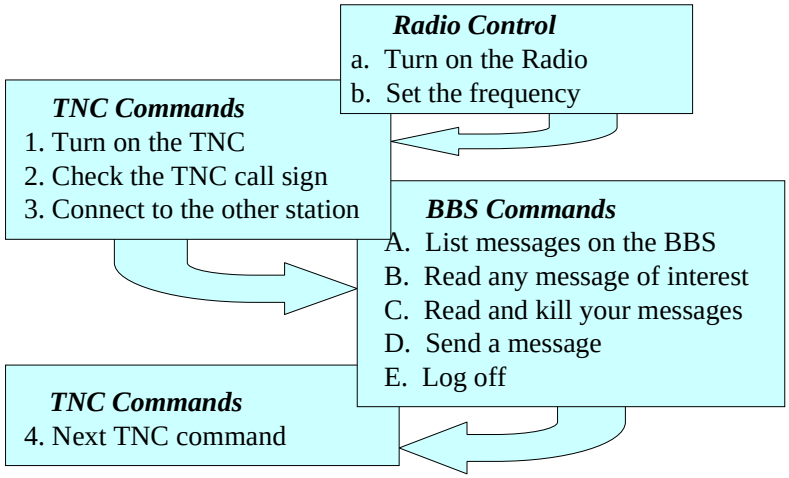
BBS Commands

Commands that control the remote BBS station

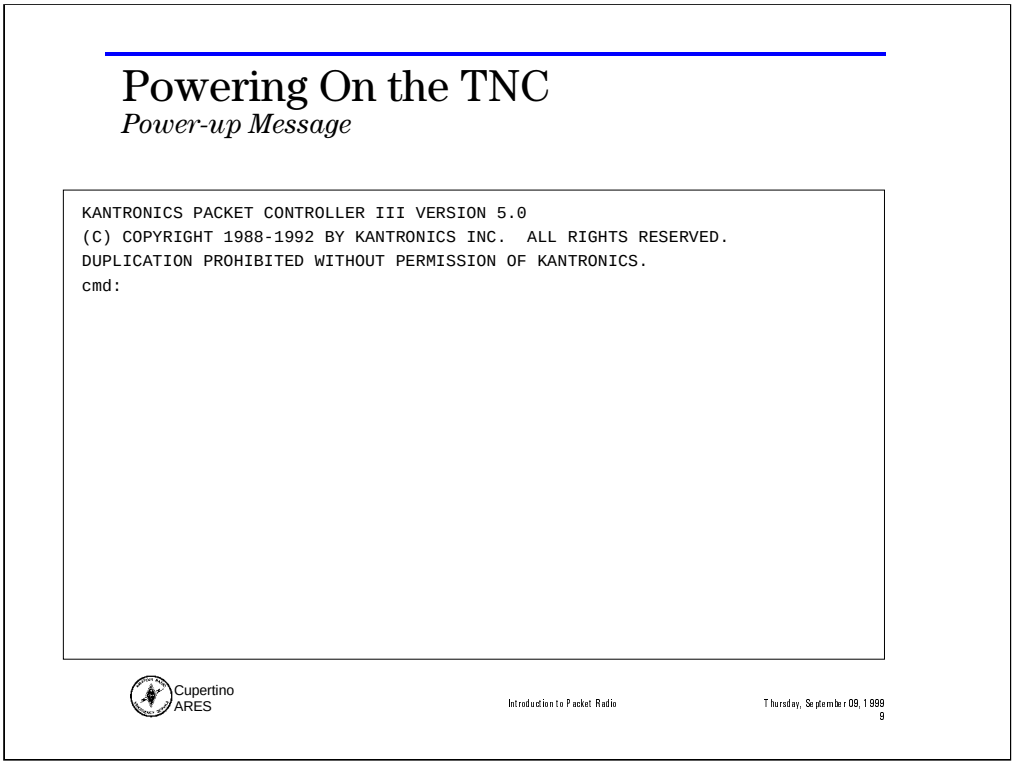
- Help, ? - displays list of commands List - lists messages you can read
- Read - read a message
- Send - send a message
- Kill - delete a message
- Bye - log off this BBS

Notes

Summary of a typical TNC session



Notes



Notes

Power-up Message.

Different TNCs will display different messages. Regardless of what the message says, on powering up the TNC, some readable message should be displayed identifying the manufacturer, firmware revision number, and a command prompt.

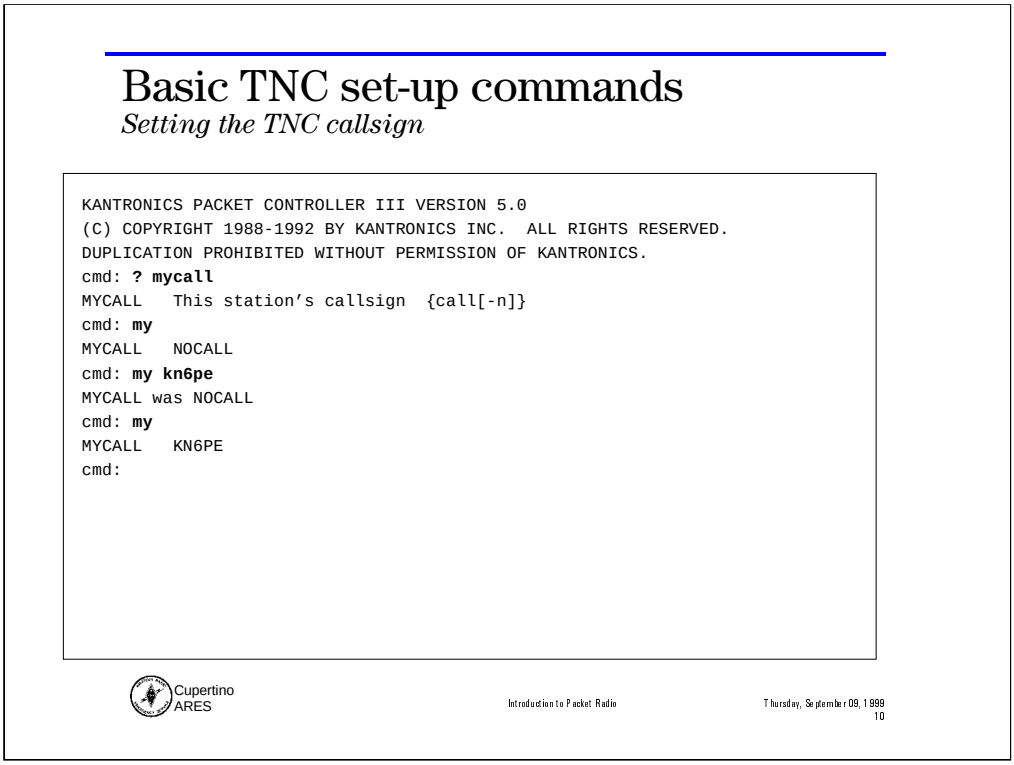
When you turn on the TNC and see a message similar ot the one above, several things have been confirmed:

- The TNC is correctly powered up and turned on.
- The cable between the Computer and TNC is connected correctly
- The settings of the TNC (Baud Rare, Parity, Stop Bits, etc) is set correctly

At this point, you can now enter TNC commands. Commands are entered either without parameters or with parameters. When entered without a parameter, the current setting associated with that command is displayed. If entered with a parameter, the setting associated with that command is changed to the new value. If either the command or parameter is entered incorrectly, then an error prompt is displayed, typically something like

EH?

Check the command syntax (format) with the HELP command, and try again.



TNC COMMAND

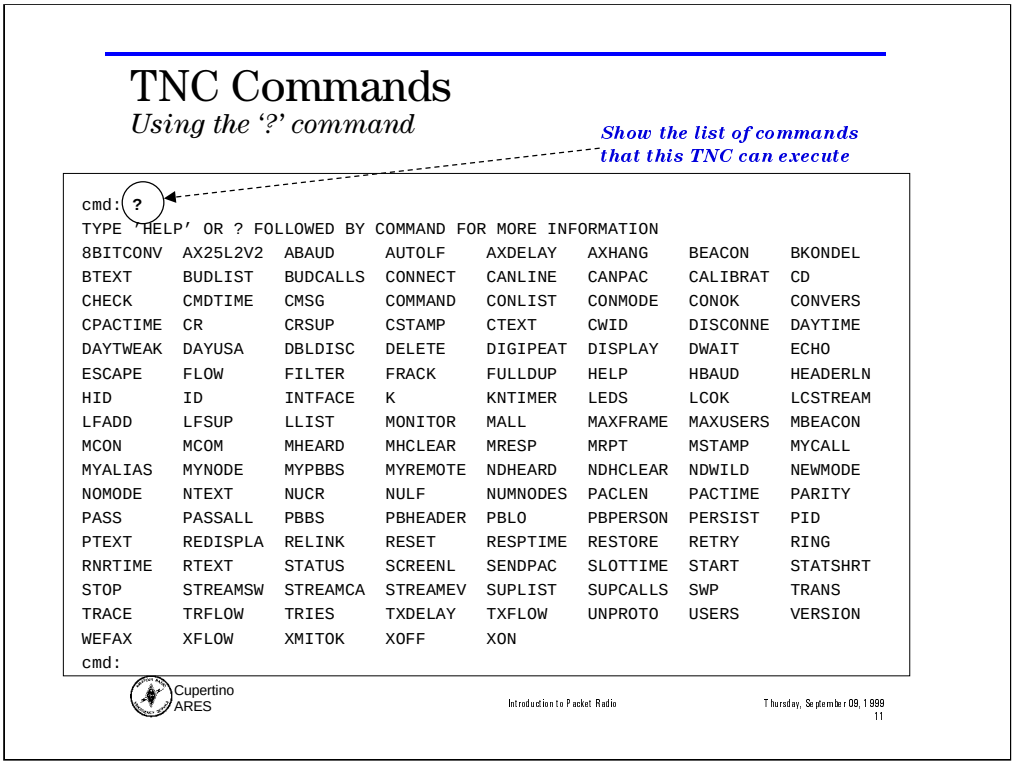
MYCALL call[-n]

Parameters:

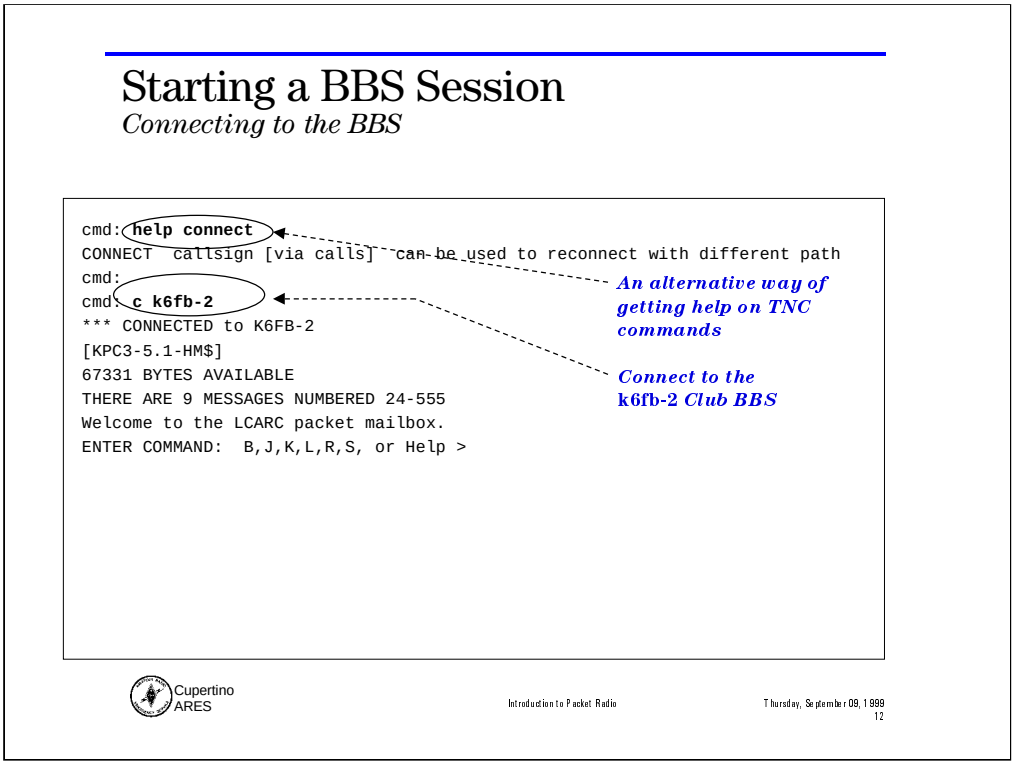
call	Callsign of your TNC
n	0 - 15, an optionally specified sub-station ID (SSID)

This command tells the TNC what its callsign is. This callsign will be placed in the FROM Address field for all packets originated by your TNC. It also accepts packets with this callsign in the TO Address field to be accepted.

The default callsign must be changed for proper operation of the protocol. There sjhould never bee more than one station with the same callsign on the air at once. The SSID is used to distinguish two stations with the same Amateur call. The SSID will be 0 unless explicitedly set to another value


TNC Commands
Using the '?' command
Show the list of commands that this TNC can execute
cmd: ?
TYPE 'HELP' OR ? FOLLOWED BY COMMAND FOR MORE INFORMATION
8BITCONV AX25L2V2 ABAUD AUTOLF AXDELAY AXHANG BEACON BKONDEL
BTEXT BUDLIST BUDCALLS CONNECT CANLINE CANPAC CALIBRAT CD
CHECK CMDTIME CMSG COMMAND CONLIST CONMODE CONOK CONVERS
CPACTIME CR CRSUP CSTAMP CTEXT CWID DISCONNE DAYTIME
DAYTWEAK DAYUSA DBLDISC DELETE DIGIPEAT DISPLAY DWAIT ECHO
ESCAPE FLOW FILTER FRACK FULLDUP HELP HBAUD HEADERLN
HID ID INTFACE K KNTIMER LEDS LCOK LCSTREAM
LFADD LFSUP LLIST MONITOR MALL MAXFRAME MAXUSERS MBEACON
MCON MCOM MHEARD MHCLEAR MRESP MRPT MSTAMP MYCALL
MYALIAS MYNODE MYPBBS MYREMOTE NDHEARD NDHCLEAR NDWILD NEWMODE
NOMODE NTEXT NUCR NULF NUMNODES PACLEN PACTIME PARITY
PASS PASSALL PBBS PBHEADER PBLO PBPERSON PERSIST PID
PTEXT REDISPLA RELINK RESET RESPTIME RESTORE RETRY RING
RNRTIME RTEXT STATUS SCREENL SENDPAC SLOTTIME START STATSHRT
STOP STREAMSW STREAMCA STREAMEV SUPLIST SUPCALLS SWP TRANS
TRACE TRFLOW TRIES TXDELAY TXFLOW UNPROTO USERS VERSION
WEFAX XFLOW XMITOK XOFF XON
cmd:
Cupertino ARES
Introduction to Packet Radio
Thursday, September 09, 1999
11

Notes



TNC COMMAND

CONNECT call

Parameters:

call Callsign of the TNC to be connected to

Connect is an immediate command. It initiates a connect request to the TNC with the entered call sign. Typically, the TNC will immediately enter the CONVERS mode and will no longer accept TNC commands.

If no response to the connect request occurs after the number of attempts specified by RETRY, the command is aborted and an error message is displayed.

BBS Commands

Using the '?' command

```
ENTER COMMAND:  B,J,K,L,R,S, or Help >
?
B(ye)          PBBS WILL DISCONNECT
J(heard)       CALLSIGNS WITH DAYSTAMP
J S(hort)      HEARD CALLSIGNS ONLY
J L(ong)       CALLSIGNS WITH DAYSTAMP AND VIAS
L [x [y]] [;] LIST MESSAGES x THRU y YOU CAN READ
L <|> call     LIST MESSAGES FROM OR TO CALL
LB             LIST BULLETINS
LC [cat]       LIST CATEGORIES
LL n           LIST LAST n MESSAGES
LM(ine)        LIST UNREAD MESSAGES ADDRESSED TO YOU
LO [+|-]       LISTING ORDER
LT             LIST TRAFFIC
K(ill) n       DELETE MESSAGE NUMBER n
KM(ine)        DELETE ALL READ MESSAGES ADDRESSED TO YOU
R(ead) n       DISPLAY MESSAGE NUMBER n
RH n           DISPLAY MESSAGE n WITH HEADERS
RM(ine)        READ ALL MESSAGES ADDRESSED TO YOU
S(end) call    SEND MESSAGE TO callsign
S[B|P|T] call SEND BULLETIN, PRIVATE, or TRAFFIC
ENTER COMMAND:  B,J,K,L,R,S, or Help >
```

Show the list of commands that are available on this BBS

Notes

Listing available Messages

Using the 'List' command

```
ENTER COMMAND:  B,J,K,L,R,S, or Help >
l
MSG#  ST SIZE  TO     FROM   DATE               SUBJECT
553   BF 2319  ALL    N6GBU  07/18/99 09:27:37  NAPA REPEATER & TCP/IP
548   PN 386   KE6CSL KN6PE  06/21/99 18:12:47  Hawaii... lucky guy!
533   B  1658  ALL    KN6PE  01/22/99 22:33:57  1999 General Meeting Schedule
238   B  318   ALL    AA6WK  11/28/95 18:22:28  BMHA Bicycle Mobile Hams of Ame
27    B  3483  ALL    AA6WK  03/18/93 21:35:15  Net Preamble
26    B  760   ALL    AA6WK  03/18/93 21:30:47  >>> how to use the node and/or
24    B  947   ALL    AA6WK  03/18/93 21:20:33  Welcome
ENTER COMMAND:  B,J,K,L,R,S, or Help >
```

List the messages on the BBS

Notes

Reading BBS Messages

Using the 'Read' command

```
ENTER COMMAND:  B,J,K,L,R,S, or Help >
r 24   <---------------------------------------------- Read Message #24
MSG#24 03/18/93 21:20:33 FROM AA6WK TO ALL
SUBJECT: Welcome
PATH: K6FB

Welcome to the Las Cumbres Amateur Radio Club's Bulletin Board.
This club also operates K6FB-7 node on 145.050 Mhz.
  :
  :
All machines are OPEN and they may be used by anyone wishing to do so.

Please make use of the K6FB-2 BBS.  After reading messages addressed directly
to you please delete them.  If you originate a message addressed to all,
please delete it within the month posted.

Thank you for reading this message....
   73  de    Las Cumbres Amateur Radio Club

ENTER COMMAND:  B,J,K,L,R,S, or Help >
```


Notes

Sending a Message

Using the 'Send' command

```
ENTER COMMAND:  B,J,K,L,R,S, or Help >
s w9bjx  <---------------------------------------- Send a Message to w9bjx
67306 BYTES AVAILABLE
SUBJECT: Scouting event  <----------------------- The subject is...

ENTER MESSAGE 556--END WITH CTRL-Z OR /EX ON A SINGLE LINE
Hi Andy,
If you want more information about Jamboree on the Air (JOTA),
check out the ARRL's web site at www.arrl.org and search for
JOTA.

regards,
jim ' kn6pe
/EX  <------------------------------------------- "/EX" ends message entry
MESSAGE SAVED
ENTER COMMAND:  B,J,K,L,R,S, or Help >
l  <--------------------------------------------------------- Do a "l" List to verify its there!
MSG#  ST SIZE  TO     FROM   DATE               SUBJECT
556   PN 177   W9BJX  KN6PE  09/06/99 20:45:48  Scouting event
553   BF 2319  ALL    N6GBU  07/18/99 09:27:37  NAPA REPEATER & TCP/IP
  :
ENTER COMMAND:  B,J,K,L,R,S, or Help >
```


Notes

Deleting a Message

Using the 'Kill' command

```
ENTER COMMAND:  B,J,K,L,R,S, or Help >
r 556
MSG#556 09/06/99 20:45:48 FROM KN6PE TO W9BJX
SUBJECT: Scouting event
PATH: K6FB

Hi Andy,
If you want more information about Jamboree on the Air (JOTA),
check out the ARRL's web site at www.arrl.org and search for
JOTA.

regards,
jim ' kn6pe

ENTER COMMAND:  B,J,K,L,R,S, or Help >
k 556
MSG#556 09/06/99 20:45:48 FROM KN6PE TO W9BJX
MESSAGE DELETED
ENTER COMMAND:  B,J,K,L,R,S, or Help >
```

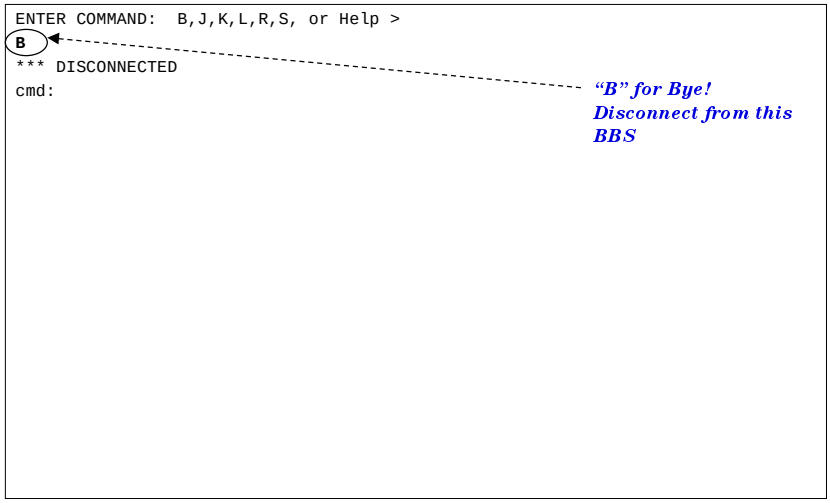
Read Message # 556

Delete this message!

Notes

Ending a BBS session

Using the 'Bye' command



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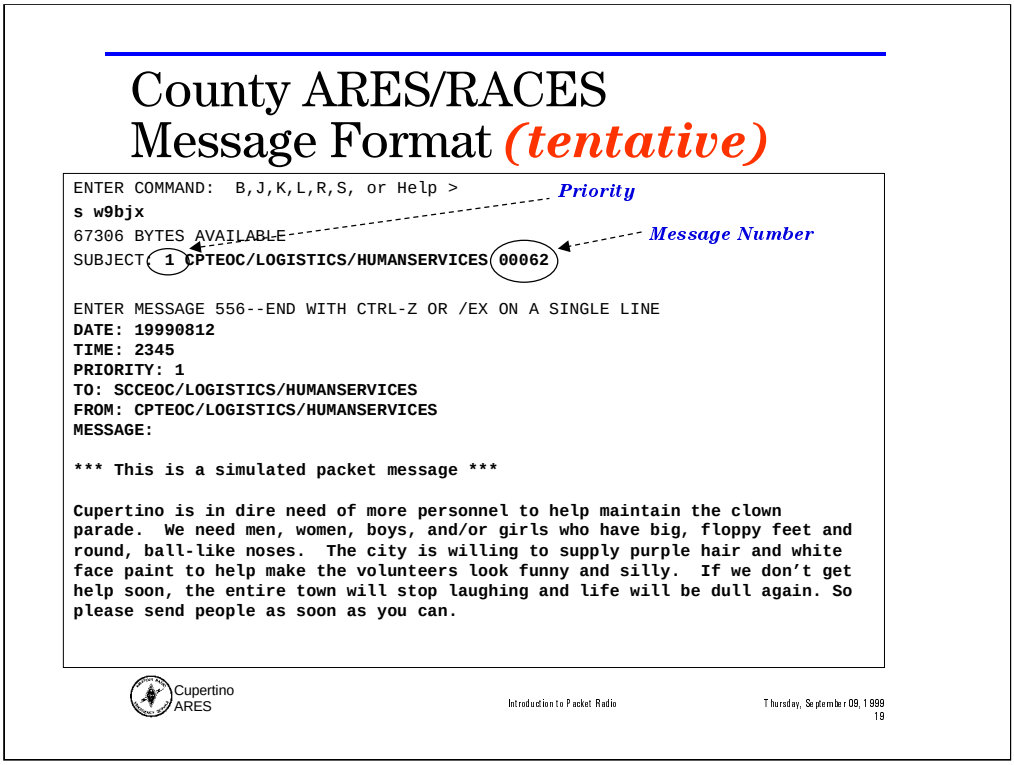


SUBJECT: 1 MTVEOC 00001
DATE: 19990812
TIME: 2228
PRIORITY: 1
TO: SCCEOC/ARES/DEC
FROM: MTVEOC/ARES/EC
MESSAGE:

*** This is a simulated packet message ***

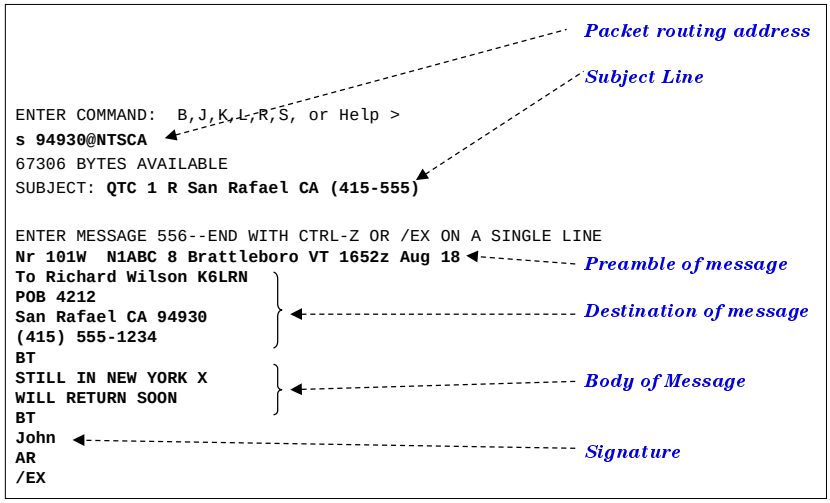
As you can see from the subject line, this message is a message with highest priority (1 = highest, 9 = lowest) coming from the Mountain View EOC and is the first message sent from the Mountain View EOC for this event.

After header information, we can send ANY information we want. The format of the information can be anything we want. This will allow formats for questions, inquiries, SEMS messages, etc. This message just happens to be information on how the packet messages can be sent.

You can see that I am sending this message to Larry who is the DEC for Santa Clara County and is located at the county EOC. You can also see that the EC for Mountain View (that's me) is sending the message to Larry. You can also note that the date is in the format YYYYMMDD which allows for Y2K and also can be used as a means of sorting. With this date format, you will always get a number representing the date that is increasing.

Terry.
KD6DIF

NTS Message Format



Notes