Getting Started in Mapping and Mobile APRS*

Automatic

Packet / **P**osition

Reporting

System

(*With apologies from VE3XK to the club packet and APRS experts)

APRS

- Operates as an application on the Packet Radio network, so is compliant with the standards and protocols of packet radio
- To understand APRS, we must start with an overview of amateur packet radio

Amateur Packet Radio

- Developed by Montreal hams in 1978 for point-to-point data communication
- Further developed by Vancouver hams
- In 1982 AMRAD defined the AX-25 Protocol (derived from the ISO X-25 Protocol).

AX.25 Amateur Packet Protocol

- Transmissions contain small blocks of information called frames
  - Information (I) Frames – contain the user data being transferred across the network
  - Supervisory (S) Frames – provide control of the communications link e.g. acknowledging receipt or requesting resend
  - Unnumbered (U) Frames provide additional control, and make it possible to send Unconnected (UI) Frames used for calling CQ, and sending announcements (beacons)
    - http://www.tapr.org/pub_ax.25.html

AX.25 Frames

FIELD:	FLAG	ADDRESS	CONTROL	FCS	FLAG
LENGTH:	8 BITS	112 - 560 BITS	8 BITS	16 BITS	8 BITS
CONTENTS:	01111110	CALL SIGNS & SSIDS OF DESTINATION, SOURCE, &, OPTIONALLY, DIGIPEATERS	FRAME TYPE	CALCU-LATED VALUE	01111110

⌐ FIRST BIT SENT   LAST BIT SENT ⌐

UNNUMBERED AND SUPERVISORY FRAMES

FIELD:	FLAG	ADDRESS	CONTROL	PID	INFORMATION	FCS	FLAG
LENGTH:	8 BITS	112 - 560 BITS	8 BITS	8 BITS	N x 8 BITS	16 BITS	8 BITS
CONTENTS:	01111110	CALL SIGNS & SSIDS OF DESTINATION, SOURCE, &, OPTIONALLY, DIGIPEATERS	FRAME TYPE	LAYER 3 PROTOCOL TYPE	USER DATA	CALCU-LATED VALUE	01111110

⌐ FIRST BIT SENT   LAST BIT SENT ⌐

INFORMATION FRAME

Modems

◆ To minimize costs, amateur packet implementation used existing Bell – system standard modulator / demodulator units (modems), as these were readily available to the amateur radio community at surplus prices as commercial customers moved up in speed.

TERMINAL — SERIAL INTERFACE — MODULATOR — INTERFACE TO COMMUNICATIONS MEDIUM — COMMUNICATIONS MEDIUM; DEMODULATOR
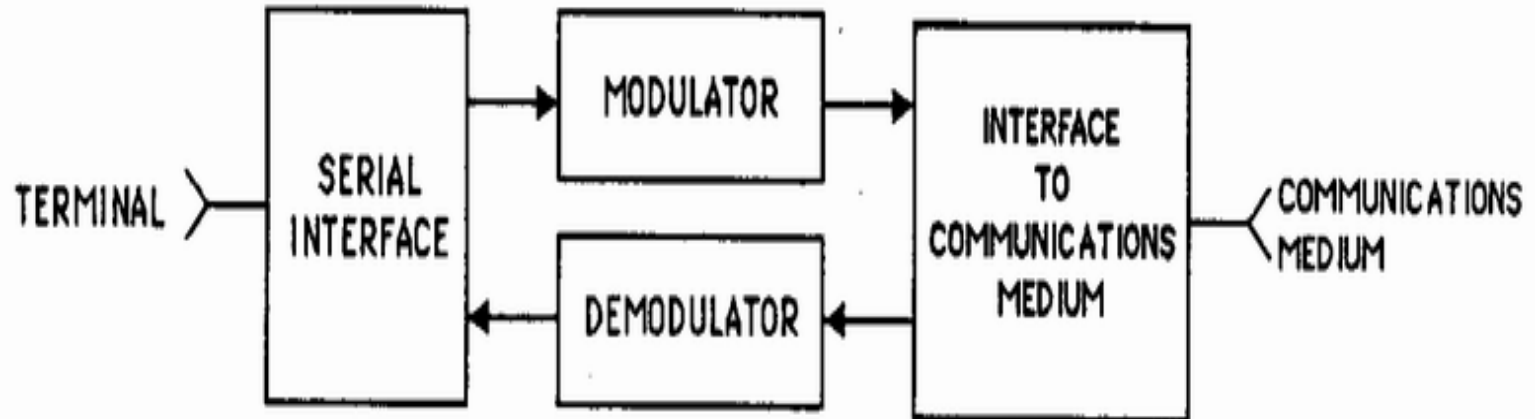
The Bell 103 Type Modem

- 300 baud (bits per second) data rate
- Frequency Shift Keying with 200 Hz shift
- At one end, modem transmits on Frequency Pair F1 (Mark 1270 Hz, Space 1070 Hz) and receives on Frequency Pair F2 (Mark 2225 Hz, Space 2025 Hz)
- At other end, operation is opposite
- This is Full Duplex, but amateur packet uses only half-duplex (sequential T and R)

The Bell 202 type Modem

- 1200 baud (bits per second) data rate
- Frequency Shift keying with 1 KHz shift
- Mark frequency is 1200 Hz and Space frequency is 2200 Hz
- This supports half-duplex (one-way at a time) operation

The Packet Assembler / Disassembler (PAD)

◆ In Transmit, the PAD accepts data from the data terminal and formats it into packet frames for transmission to the communications medium. In Receive, the PAD extracts data from the received frames, and transfers the data to the terminal
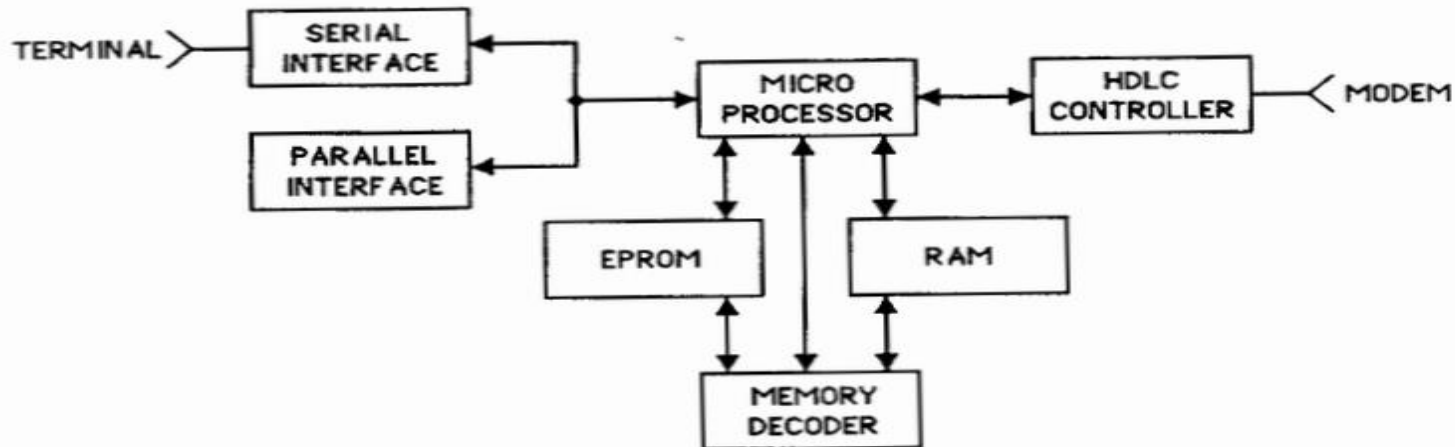
The Terminal Node Controller (TNC)

◆ It was not long before the early ham developers combined the functions of modem and PAD into one unit they called a TNC.

◆ TNC is software programmable with both EPROM and RAM memory on board

◆ Over the years the PAD has evolved from the original Vancouver VADCG TNC, through the later AX25-compatible TAPR TNC-1 and TNC-2 models and various commercial TNC models

(TNC) (continued)
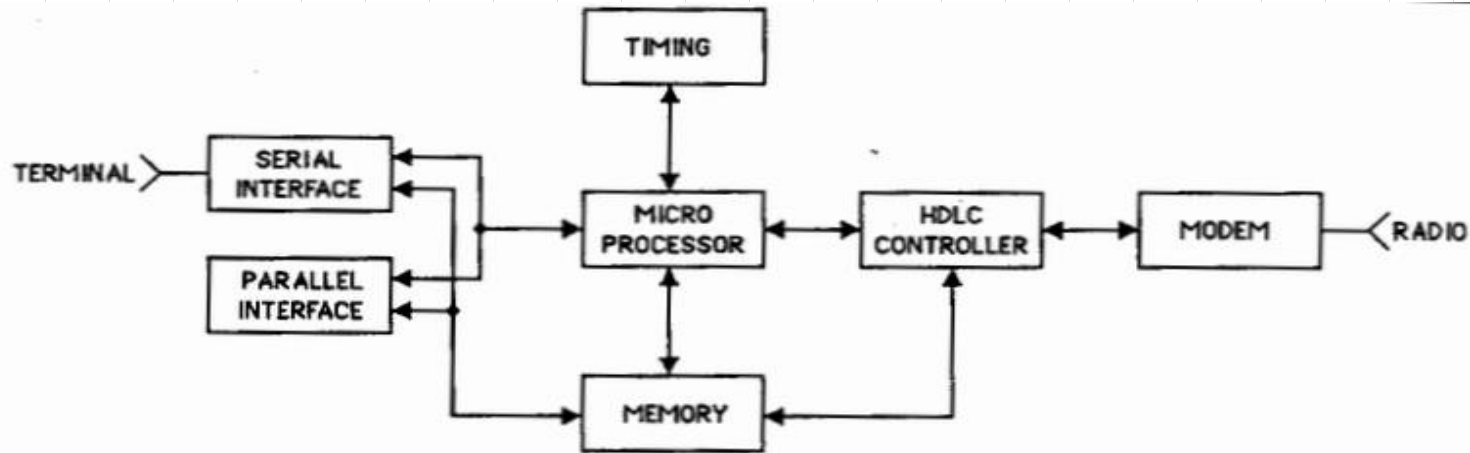
- For packet Transmit-Only operations, some TNC functions can be omitted, as there is no need for packet disassembly.
- APRS Tracker units like Tiny-Trak3 use Transmit-Only and do not require full TNC functionality.

Digital Repeater (Digipeater)

- The digipeater is an essential building block in the packet network as it extends the range of all terminal nodes.

- Unlike voice repeaters that retransmit everything they receive, the digipeater temporarily stores and then retransmits (repeats) only the packet radio transmissions that are specifically addressed for routing through that digipeater, or aliases (eg WIDE, RELAY, etc) accepted by that repeater.

APRS Software

- Used in a suitable platform (desktop, laptop or PDA computer)
- Connects to a TNC to receive and display APRS packets from a transceiver as positions on a computer-generated map
- Transceiver may be base station, mobile or handheld on 144.390 FM, or 10.151 MHz LSB
- Transmits beacons or messages, as required.

Platforms & Supported Software

- ◈ Today's desktop and laptop computers usually have enough speed and capacity to display high-resolution maps in colour
  - Win APRS http://www.winaprs.org/
  - UI-View http://www.UIView.com/
- ◈ Personal Digital Assistant units (PDA) usually are now also able to support high resolution maps in colour
  - Palm APRS http://www.tapr.org/palmstuff

Mobile Installation Considerations

- ◈ Physical space
  - Laptop screens are easier to read but hard to fit into a car environment, though may be ok for some trucks and motor homes
  - Palm or Pocket PC screens are easier to fit but buttons are hard to operate safely in car, when used to send messages

Mobile Installation Considerations (cont'd)

- A compact 12V mobile TNC provides both APRS send and receive capability. e.g. TNC-X http://www.tnc-x.com/

- Tracker function or digipeat function (not both) can be added to TNC-X.

- However, unless text message send/receive and/or map display functionality is required, a TNC is not needed.

- Tiny-Trak3 is the most compact and cheapest tracker solution at around US$50 plus handheld and 2M antenna. http://www.byonics.com/

APRS Mobile Considerations

- To prevent frames bouncing forward and backward endlessly between two or more digipeaters, the present recommendation is to set a mobile Digipath setting to WIDE1-1,WIDE2-1. This allows both wide area and normal digipeaters to digipeat your mobile, but limits the bounces.

Kenwood TM-D700A Data Communicator Radio

- Model TM-D700A adds APRS functionality to a 2m/70CM dual band mobile transceiver.
- Provides positional/directional data (text only), interface for GPS antenna, mobile digipeat capability, versatile text messaging (internal memory for 16 stored messages)
- http://www.kenwood.net/

Kenwood TH-D7A Handheld Data Communicator

- Adds APRS functionality to a 2m/70CM dual band handheld transceiver.
- Provides positional/directional data (text only), interface for GPS antenna, mobile digipeat capability, versatile text messaging (internal memory for 16 stored messages)
- http://www.kenwood.net

HamHUD II Heads Up Display

- Added to a VHF transceiver and TNC, the HamHUD II provides the functionality of the Kenwood TM-D700A or TH-D7A radios:
    - Automatic GPS detection, or manual insertion
    - 4-line X 20 character LCD display
    - Beeper indicates incoming messages
    - "Whiz wheel" knob with button
    - "Smart Beaconing" of position
    - Hook Mode eases station rendezvous
    - PCB with case and all parts (kit) - initially US$113
        - http://www.hamhud.net/hh2/

APRS System Enhancements

◆ APRS-Compatible Weather Station (windspeed/direction, temperature / dewpoint, humidity, barometric pressure)

Peet Brothers Ultimeter 2100

- ▪ http://www.peetbros.com/

◆ Internet Gateway Stations (I-Gates)

- ▪ Feed central APRS database in Miami
  - ◆ http://www.map.findu.com/callsign

Trip Planning and Plotting

- Handheld GPS units with internal map and position plotting software are available. Costs are higher for the larger screen and higher resolution colour displays. The Tom Tom unit is highest rated, though the Garmin is also very good.
- Laptop with external GPS antenna.
    - Microsoft Streets and Trips http://www.microsoft.com/streets/products.aspx
    - Delorme Earthmate http://www.delorme.com/earthmate/default.asp
- Palm, Pocket PC with external GPS antenna
- In all cases be cautious about Canadian map coverage, which can be poor compared with USA

Trip Planning and Plotting (cont'd)

- A newer laptop with Windows XP and clock speed of 1 GHz+ are needed to support audible voice prompted directions from the system. Without that capability, systems may be seen as a solo-driving hazard (may only be safely (?) used by a passenger / navigator).

- The newest PDAs and self-contained mapping units offer voice "turn" instructions.

SUMMARY

- No need to be an expert to run APRS. Just follow simple rules.
- For solo-driving safety, Trip Planning should be limited to voice prompted directions, which means higher cost (high clock rate, Windows XP, laptop). Otherwise a competent navigator needed.
- APRS and Trip Planning applications may be run in one laptop or a newer PDA and the latest software overlays APRS positions on the map display http://www.kh-gps.de/aprsdece.htm.
- Unless text messaging is needed stick with Tiny Trak3 for minimal cost (~$50) and space, but no APRS display in the car.
- To add text messaging and limited display, use Kenwood TM-D700A or TH-D7A APRS radios, or (for less money) add TNC-X with HamHUD to conventional VHF radio. No need to add Tracker or Digipeat functions to TNC-X as HamHUD has those features.
- Thanks for your time and attention   *ve3xk*