TNC-Pi9k

9600 baud TNC for the Raspberry Pi
Based on the Teensy 3.6 Microcomputer

Available from PJRC Electronics

TNC-Pi9k Developed by John Wiseman, G8BPQ (I named it)

Actual Teensy size is 2.4 by .7 inches

Features a 32 bit 180 MHz ARM Cortex-M4 processor with a built in floating point unit and 512 MB RAM

Other components just a dual op-amp and a digital potentiometer

Everything is done in software!

Mini-USB port on left for programming

Mini-SD card socket on right is not used
Programming done in “C” using the Arduino software development tool on a Windows computer

Based upon the Thomas Sailer Soundmodem software

Plug mini-USB into port from Windows machine and compiled software is automatically uploaded and the board rebooted

Can also use the new ARDOP protocol which is faster than 1200 packet (requires recompiling and reloading software)

ARDOP for Linux requires a driver not yet available. May be coming soon.

Works with LINBPQ
Appears to the Raspberry Pi as a hardware KISS TNC
Straight plug in replacement for the current TNC-Pi2
2400 baud mode is available but may not work due to radios
Some Definitions

• Baud = bps (BITS per second)
• BER (Bit Error Rate) nbr of errors / total bits sent, expressed as $10^{-n}$
• CRC (Cyclic Redundancy Check) is an error detecting code
• Frame and Packet
  • Both are packages of data moving through a network (OSI model)
  • Frames are units of data in the Link Layer (layer 2)
  • Packets are units of data in the Network Layer (layer 3)
  • Both terms are often used interchangeably but not technically correct
My Perspective (Red Arrow)

Building with Free WiFi and connection to The Internet

PiGate RMS in car with VHF/UHF radio

VHF/UHF radio link Sending email traffic

Car with VHF/UHF radio. PiGate is inside

Basic PiGate RMS Setup

The Internet

You and your cell phone Inside disaster shelter linked to PiGate in car
Radio Data Transfer Speeds

• Highly dependent upon the frequency bandwidth available
• OTA DTv requires 6 MHz bandwidth for 32 Mbps (more with compression)
• 4G LTE cell phones in the 800/900/1200 MHz frequencies can have up to 20 MHz bandwidth to achieve 300 Mbps downloads
Amateur Radio Data Transfer Speeds

• For amateur radio bandwidth is significantly less!
• Slow scan TV must fit into a 3 KHz SSB transmission
• Capabilities can be determined by the Shannon-Hartley theorem
  \[ C = B \log_2 (1+S/N) \]
• C is the channel capacity in bits per second
• B is the channel bandwidth in hertz
• S is signal power measured in watts
• N is the average noise over the band measured in watts
Radio Data Transfer Speeds

• This means for an average 15 KHz FM signal, 100 Kbps is possible under the absolutely BEST conditions (no noise)
• 9600 baud (9.6 Kbps) is easily within reach
Packet Frequencies

• 10 Meters – 1200 baud FM – not very reliable
• 6 meters – 1200 baud FM – works in low noise environments
• 2 meters and up – 1200 to 9600 baud FM
• 220 MHz may be the ideal packet band – hard to find radios
• Useful if you have full control of both ends of the comm link (such as using the PiGate and PiGate RMS system)
Packet Radio Modulation

- Two modes, AFSK and FSK (audio frequency shift and frequency shift keying)
- In use for a long time, starting with RTTY many years ago
9600 Baud Packet

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<thead>
<tr>
<th>IC-2820H</th>
<th>IC-208H</th>
<th>FT-8000R</th>
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<tbody>
<tr>
<td>FT-8800R</td>
<td>FT-7800R</td>
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<td>TM733A</td>
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Why do I want 9600 baud?

Faster transfer, duh!

Faster than WINMOR
Faster than PACTOR 1, 2, or 3
Faster than ARDOP
Ability to transfer larger files in a “reasonable” time
However, no error correction
Good signal link is a MUST
In what real world situations would I need faster data transfers?
Imagine you're at a disaster site
USA 24 Hour Forecast (54KB)
72 Hour Forecast FAX (47KB)
Similar WEFAX Image from FLDIGI
What data transfer rates can I expect?

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• A GOOD radio link is REQUIRED!
The Test Environment

eliminating variables

• Two TNC-Pi9k boards setup exactly the same
• Connected to two FT-7900 radios thru the packet data port
• A PiGate RMS connected to a roof top 2m/70cm omni antenna
• A PiGate in the basement with a 0 gain whip antenna
• Two floors and a roof between them
• Both radios set for 433 Mhz
• Both radios transmit at 5 watts
• Both radios un-squelched
• Packet parameters on both ends setup the same
• Same files used for all tests
The Test Results

as measured by linbpq
Test Results

Bits per second

- 9600
- 1200
Test Results

Time (in minutes)

- 112KB: 9600 minutes
- 54KB: 1200 minutes
- 10KB: 600 minutes
- 5KB: 1200 minutes
Test Results

Bits per second

- 9600
- 1200

112KB  54KB  10KB  5KB
Test Results

Bits per second
Again – Good Signal Link REQUIRED!

Not this!
This!!
How much will it cost?
Questions?