# NCPA *Downlink*

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## President's Message

Gary Mitchell, WB6YRU

Here's the Spring issue... in early September <ahem>. Hopefully we'll have the Summer issue out while it's still summer. ☺

In the last issue, a first draft of the proposed "big change" to the bylaws (and hence the structure of the organization) was published. So far, only one comment was made–and that was only after directly requesting a comment. Apparently, no one has any strong feelings one way or the other. Is that really true? A major structural change to the organization like this should spark at least some debate.

If you have anything to say about restructuring the NCPA or the bylaws, please do so soon. In the next issue the final proposed version will be published. That's the one you'll be asked to vote on at the next general meeting.

Voting on the bylaws is kind of a big deal, we'll need a decent turn-out for the vote to be valid. So, please plan on attending.

The next general meeting time and place hasn't been set yet, but most likely will once again be on Saturday at Pacificon in October, in Concord. We tend to get the best turn-out when having meetings there.

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## News from the ARRL

From *The ARRL Letter*, August 8, 2003

LEAGUE DOCUMENTS DIGITAL MODES

With a new Web page on digital mode specifications, ARRL hopes to make answering the question "Is that mode legal?" a lot easier.

Until 1995, the only permissible digital modes under Part 97 rules were RTTY and modes that used ASCII codes. On November 1 of that year, the FCC--acting on an ARRL petition--agreed to allow the use of any digital mode, providing its technical characteristics were "publicly documented"--§97.309(a)(4)--and the HF digital mode explosion began in earnest.

To make finding technical specifications for existing and emerging digital modes more convenient, ARRL now provides technical documentation for many modes now in use on its "§97.309(a)(4) Technical Descriptions" page <http://www.arrl.org/FandES/field/regulations/techchar/>.

"We needed a better place to find whether a technique has been published," said ARRL Technical Relations Manager Paul Rinaldo, W4RI, in explaining the move to make the information more readily available. "A place on the Web seemed to be the best way of letting the amateur community know that a technique is published as well as providing an accurate technical description of what it is."

The documentation is adequate to recognize the technique or protocol when observed on the air, to determine the call signs of stations in communication and to read the content of their transmissions. The page currently contains technical descriptions of CLOVER, CLOVER-2000, G-TOR, PACTOR, PACTOR-II and PSK31. Volunteers are developing documentation for MT63, PACTOR-III, MFSK-16 and Q15X25 for later

## In This Issue

addition.

The ARRL invites help from designers, manufacturers, users and user groups to fill in the gaps for additional modes. Send information or inquiries to ARRL Technical Relations Manager Paul Rinaldo, W4RI <w4ri@arrl.org>.

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# Packet Layers for the ISO/OSI and TCP/IP Network Models

## The ISO/OSI Network Model

The standard model for networking protocols and distributed applications is the International Standard Organization's Open System Interconnect (ISO/OSI) model. It defines seven network layers.

**Layer 1 - Physical**
Physical layer defines the cable or physical medium itself, e.g., thinnet, thicknet, unshielded twisted pairs (UTP). All media are functionally equivalent. The main difference is in convenience and cost of installation and maintenance. Converters from one media to another operate at this level.

**Layer 2 - Data Link**
Data Link layer defines the format of data on the network. A network data frame, aka packet, includes checksum, source and destination address, and data. The largest packet that can be sent through a data link layer defines the Maximum Transmission Unit (MTU). The data link layer handles the physical and logical connections to the packet's destination, using a network interface. A host connected to an Ethernet would have an Ethernet interface to handle connections to the outside world, and a loopback interface to send packets to itself.

Ethernet addresses a host using a unique, 48-bit address called its Ethernet address or Media Access Control (MAC) address. MAC addresses are usually represented as six colon-separated pairs of hex digits, e.g., 8:0:20:11:ac:85. This number is unique and is associated with a particular Ethernet device. Hosts with multiple network interfaces should use the same MAC address on each. The data link layer's protocol-specific header specifies the MAC address of the packet's source and destination. When a packet is sent to all hosts (broadcast), a special MAC address (ff:ff:ff:ff:ff:ff) is used.

**Layer 3 - Network**
NFS uses Internetwork Protocol (IP) as its network layer interface. IP is responsible for routing, directing datagrams from one network to another. The network layer may have to break large datagrams, larger than MTU, into smaller packets and host receiving the packet will have to reassemble the fragmented datagram. The Internetwork Protocol identifies each host with a 32-bit IP address. IP addresses are written as four dot-separated decimal numbers between 0 and 255, e.g.,

129.79.16.40. The leading 1-3 bytes of the IP identify the network and the remaining bytes identifies the host on that network. The network portion of the IP is assigned by InterNIC Registration Services, under the contract to the National Science Foundation, and the host portion of the IP is assigned by the local network administrators, locally by noc@indiana.edu. For large sites, usually subnetted like ours, the first two bytes represents the network portion of the IP, and the third and fourth bytes identify the subnet and host respectively. Even though IP packets are addressed using IP addresses, hardware addresses must be used to actually transport data from one host to another. The Address Resolution Protocol (ARP) is used to map the IP address to it hardware address.

**Layer 4 - Transport**
Transport layer subdivides user-buffer into network-buffer sized datagrams and enforces desired transmission control. Two transport protocols, Transmission Control Protocol (TCP) and User Datagram Protocol (UDP), sits at the transport layer. Reliability and speed are the primary difference between these two protocols. TCP establishes connections between two hosts on the network through 'sockets' which are determined by the IP address and port number. TCP keeps track of the packet delivery order and the packets that must be resent. Maintaining this information for each connection makes TCP a stateful protocol. UDP on the other hand provides a low overhead transmission service, but with less error checking. NFS is built on top of UDP because of its speed and statelessness. Statelessness simplifies the crash recovery.

**Layer 5 - Session**
The session protocol defines the format of the data sent over the connections. The NFS uses the Remote Procedure Call (RPC) for its session protocol. RPC may be built on either TCP or UDP. Login sessions uses TCP whereas NFS and broadcast use UDP.

**Layer 6 - Presentation**
External Data Representation (XDR) sits at the presentation level. It converts local representation of data to its canonical form and vice versa. The canonical uses a standard byte ordering and structure packing convention, independent of the host.

**Layer 7 - Application**
Provides network services to the end-users. Mail, ftp, telnet, DNS, NIS, NFS are examples of network applications.

## The TCP/IP Network Model

Although the OSI model is widely used and often cited as the standard, TCP/IP protocol has been used by most Unix workstation vendors. TCP/IP is designed around a simple four-layer scheme. It does omit some features found under the OSI model. Also it combines the features of some adjacent

# DX Spotting Nodes

September 2002

| Location | Call | Alias | Frequency | Coverage |
|---|---|---|---|---|
| California City | K6ZZ | | 144.490 | Antelope Valley area |
| | EARN8 | | 144.490 | Oak Peak |
| Castro Valley | W6RGG | DXCV | 145.770 | East, West, South SF Bay area |
| Chico | K6EL | DXC | 145.670 | Chico |
| | K6EL | DXW | 145.670 | Oroville, Red Bluff |
| | K6EL | DX | 144.950 | South Fork Mtn - Redding area |
| Hanford | K6UR | DXFRES | 144.950 | Bear Mtn, Fresno area |
| | K6UR | DX7 | 145.770 | Mt. Adelaide, Bakersfield |
| | K6UR | DX16 | 145.770 | Oakhurst |
| Livermore | NF6S | DXL | 145.770 | Tri-Valley area |
| Los Gatos | N6ST | DXLG | 146.580 | Santa Cruz Mtns, Monterey Bay |
| | N6ST | DXF | 146.580 | Santa Cruz/Los Gatos |
| Oakdale | K6OQ | | 146.580 | Modesto area |
| Penngrove | K6ANP | DXANP | 145.670 | Sonoma County |
| Reno, Nevada | N7TR | RENODX | 144.950,146.58,441.500 (2400 baud), 51.7 | |
| | N7TR | PCDX1 | 146.580 | Low Level in Reno |
| | N7TR | PCDX | 144.950 | Virginia City, NV |
| | N7TR | DX2400 | 441.500 (2400 baud) | |
| Rio Linda | K6NP | DXRL | 144.950 | Sacramento, Woodland, Davis |

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OSI layers and splits other layers apart. The four network layers defined by TCP/IP model are as follows.

**Layer 1 - Link**
This layer defines the network hardware and device drivers.

**Layer 2 - Network**
This layer is used for basic communication, addressing and routing. TCP/IP uses IP and ICMP protocols at the network layer.

**Layer 3 - Transport**
Handles communication among programs on a network. TCP and UDP falls within this layer.

**Layer 4 - Application**
End-user applications reside at this layer. Commonly used applications include NFS, DNS, arp, rlogin, talk, ftp, ntp and traceroute.

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## Packet Sysops of Northern California Packet Bulletin Board Systems

**January 2003**

| Call | Location | | User Ports |
|---|---|---|---|
| WH6IO | Benica | | 144.99, 145.71&+, 145.75&, 433.43&+ |
| WA6ZTY | Berkeley | | 144.97 |
| KE6I | Berkeley | | 145.01&, 433.43& |
| N6RME-1 | Diamond Springs | | 145.07 |
| N6CKV | Gilroy | | 144.99 |
| N6LDL | Los Gatos | | 144.97, 145.71&, 441.50 |
| KD6DG | Redding | | 145.09 |
| W6CUS-1 | Richmond | | 145.63 |
| N0ARY-1* | San Jose | * | 144.93, 433.37& |
| K6YV | Sonora | | 144.97 |
| WA6EWV-1 | South Lake Tahoe | | 144.97 |
| W6YX-9* | Stanford Univ | * | 145.75+ |
| W6SF | Stockton | | 144.99 |

Keys:
& = 9600 Baud Port
+ = TCPIP Port
* = Currently Inactive

# The Layperson's Guide to High Speed Amateur Packet Radio

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Amateur Packet Radio has traditionally been a 1200 bits/sec terminal to terminal chat or bulletin board system. Many people have been introduced to the world of data communications by connecting their terminal node controller (TNC) to a VHF radio and exploring the world of radio based data communications. This has been a useful experience but has found little real value apart from handling rudimentary electronic mail (e-mail) at an unbearably slow pace. Yet it thrives due to it's usefulness and simplicity.

The next generation of packet radio is here now. It is more complex than traditional packet radio, but far more versatile and much, much faster. The versatility is due to the work in computer networking that has built the Internet. The speed is due to the availability of high speed modems and suitable RF gear.

To understand what makes high speed packet radio useful, one has to look first at a few of the applications and compare that to a dial-up line or a conventional packet radio system. In the computer communications world, a set of protocols called TCP/IP has emerged as the foremost computer networking standard. Virtually every mainframe, mini, workstation and personal computer either has or can be equipped with the appropriate software to speak "TCP/IP". TCP/IP is not limited to normal computer communications equipment such as Ethernet or telephone lines. In fact, it was designed to be extremely versatile and it is not tied into any given application either. For example, you do not need a different communications protocol to handle e-mail or search a database remotely. In fact, TCP/IP can handle both of these and many more applications simultaneously. A terminal session, on the other hand, on a telephone dial-up line can often only handle a single session such as logging into a mainframe. If you want to transfer a file from the mainframe, you have to suspend your terminal session and wait until the file transfer is complete and only then can you resume your terminal session. TCP/IP lets you do both simultaneously and share the channel with other users too.

TCP/IP is reliable and robust as well. The initial requirements from which TCP/IP was born came from the U.S. Military. They wanted a method which allowed computers to intercommunicate in a hostile environment. That meant that no single path or piece of equipment could be a point of failure. If a given site which relayed data was put out of commission, the data still had to flow. The flow could slow down if necessary but all efforts had to be made to ensure that the data would still get it its ultimate destination. Also the communications scheme had to be able to function in a changing environment. Again, if a site was put out of commission there was to be little or no human intervention to get data flowing again via an alternate path. The chosen method had to be able to operate over a variety of communications mediums as well. From dedicated lines, to satellite links to optical fibre, the communications protocol should be able to use all of them seamlessly. Finally, the communications scheme had to be vendor independent. The military did not want to be locked into a certain suppliers computer networking product and computers of different manufacture and operating systems had to be able to communicate and share data with one another.

From these ideas was born TCP/IP. TCP/IP is the software which handles the details of data communications. It interfaces to the user application programs such as an e-mail client or login client and provides a two way data connection to the physical hardware. TCP/IP on one computer will talk to TCP/IP on another computer even if it has to go through another computer to get to it's destination or if the computers are of different manufacture and run different operating systems.

TCP/IP itself consists of two fundamental parts. IP or Internet Protocol sets the basic rules for formatting packets to get the data out over a network. It gets a "packet" or piece of the message for a given destination and tries it's very best to send it to it's destination. If it receives a packet from another destination it decides whether to pass it on the next site or computer or send it up to the TCP layer if it is for this site. The TCP or Transport Control Protocol provides a "reliable stream service". This makes sure that all the packets which comprise a given message actually get to the destination in order and without duplicate data. When a message is given to the TCP layer by an applications program, such as an e-mail client, TCP breaks up the message into a number of packets and makes sure each packet is received at the destination and reassembled in the order of the original message. IP which has received the message as a number of packets from the TCP layer is only concerned with getting the message to the next site on it's ultimate way to the message's destination. Each packet can take a different route to the destination. TCP is responsible for reassembling the message at the destination.

It is this method of breaking down a message into a number of packets, each with destination (and source) information, that makes TCP/IP robust. Since each packet contains all the information to reach it's destination there is no reason that all packets have to take the same route. When IP's routing algorithms are made to learn the network around a given site, then a packet can reach it's destination even if an intermediate site no longer exists or is overloaded. IP at a given site simply tries to send the packet one step closer to it's destination.

The technical details of implementing the various protocol layers and routing are somewhat more complex than just described, but they are simple concepts. Just break a message into "packets", add a header telling where the packet is going and who it is from. Send the packet to the IP layer and try to get it one step closer to the destination site. If a site is busy or disappears send the packet to the next suitable site. Always try to get one step closer; and finally at the destination reassemble the original message from all the packets received.

All the versatility and reliability of TCP/IP does not come for free. The price you pay is overhead. For each IP datagram extra information must be carried such as the destination address. For TCP even more "extra" information must be carried. This is why TCP/IP does not work well on very low speed data channels with small packet sizes. The header just takes up too much valuable bandwidth. There are two solutions to this problem. One technique is to remove or compress the header. If the header is no longer needed why not remove it? Unfortunately it is all too often needed since a packet may have to be passed on to another site. Compressing or encoding the header to remove all the redundant information in a known manner so it can be fully reconstructed later is a good idea. But while we are at it, why not compress the data too and get an advantage on it as well. The second and "brute force" technique is to get a high speed data channel which can carry a large sized packet. This is the more common approach and it is the reason why we decided to develop some high speed radio equipment.

Traditional amateur radio packet networks were based on a 1200 bits/sec data rate. At the time it seemed like a good idea, 1200 bit/sec modems were becoming inexpensive and they could be easily coupled to an FM voice radio with little or no modification. This worked fairly well in simple point to point circuits. As more network oriented functions were added 1200 bits/sec became essentially useless, and even more useless if there was a considerable amount of traffic to carry. To carry higher speed data the radio design must be changed and simple modifications are no longer suitable.

56 kilobits/sec was chosen as a suitable speed for a data transmission for several reasons. First, experience in a university and research laboratory environment with connecting to the Internet showed that a 56 kilobit/sec channel provided

reasonable performance using TCP/IP. Second, 56 kilobit/sec modems are fairly easy to design and satisfactory modem design was available from another amateur radio group. Also, the modulation technique used by this modem did fit within the bandwidth requirement set down by Industry Canada for the UHF (440 MHz) amateur frequency allocations. Finally, software currently exists which allows the use of an inexpensive personal computer to be used as either a standalone terminal or as an IP router.

Once we leave the software levels of TCP/IP, there is one final software layer; the physical interface device driver. The device driver actually takes the IP packets and places them into the appropriate registers and memory areas for the physical interface to use. The physical interface is actual hardware which sends or receives a bit stream. In some cases the hardware is designed to operate over a cable such as Ethernet and in the case of a 56 kilobit/sec radio link the hardware formats a bit stream to send to the modem.

The modem is the heart of the radio equipment. On the transmit side it takes the data from the physical interface and generates a signal which is suitable for radio transmission. It may not yet be at the correct frequency and power level but is of the correct format. The format used in the 56 kilobit/sec radio is called Minimum Shift Keying or MSK. In this case, a 1 or a 0 from the data stream is encoded as one of two different carrier frequencies. The spacing between the carrier frequencies is minimized to conserve radio spectrum bandwidth. Also, these carrier frequencies are synchronized with the data rate which helps to conserve a bit more bandwidth. Since radio spectrum bandwidth is a limited resource and Industry Canada sets limits in terms of bandwidth for most frequency allocations, we have to choose a technique which meets the appropriate IC limits. In our case the amateur radio regulations limit the bandwidth to 100 kHz. The 56 kilobit/sec data when modulated using MSK is approximately 85 kHz wide. Other modulation techniques could be used which require less bandwidth but far more complex and expensive to implement.

Once the data stream is encoded or modulated onto a carrier, we now need to amplify and translate the modulated signal to the final carrier frequency. This is done in the up converter and power amplifier. First the signal is passed through a mixer which shifts the frequency from 28 MHz where the initial modulation took place to 432 MHz. The mixer also requires a signal source which is used to shift the modulated signal. The mixer essentially operates as a frequency adder or substracter. In this case the 28 MHz signal is added to an external signal of 404 MHz which gives us an output of 432 MHz. This is the desired signal. The 404 MHz signal comes from frequency adjustable signal source and by changing the frequency of that source we can change the output frequency. This allows a number of transmitters to occupy side by side frequencies.

The 432 MHz signal from the mixer is not yet strong enough for transmission over any great distance. We pass it though an amplifier and then to the antenna. The power levels chosen are sufficient to allow reliable data communication over a link up to 90 miles if the sites are unobstructed. Radio propagation at 432 MHz behaves similar to light. We cannot communicate around mountains but we can communicate into shallow dips and valleys.

If we want to communicate over long distances, we can cascade equipment and relay the signal further. Also, radio is a broadcast medium. We are not limited to a single point to point circuit on a given radio frequency. Several sites can share the same frequency. If they can all hear each others transmissions, then they simply appear to be connected by a single "wireless" network. This behavior is very much like connected computers on a local Ethernet. If they cannot hear each other due to obstructions or distance then two options exist. First a repeater can be put in place on a site which overlooks all the other sites and can relay messages from one site to another. In fact the repeater can be a standalone site or another site which has be configured to act as a repeater and as a user access site. Another approach is used when a large network is needed or when traffic loads get too high. In this case the routing mechanism of IP is used to connect two networks. The IP software is told that it is to allow IP packets from one network which is coming for one physical interface to be repeated to another network on another physical interface. Only the IP packets which are destined to the next network are passed. This reduces congestion on both networks and allows messages from one network to reach the other. The IP software can operate with multiple radio or cable physical interfaces. Thus, a fairly complex network comprising of radio equipment and standard computer equipment can easily built up.

When a packet is received by a given site as a radio signal, it needs to processed into an IP packet so that it can be passed to the TCP layer at the site or passed onto the next site using IP. To do this, we first amplify the weak signal received on 432 MHz and then using another mixer we shift the frequency back down to 28 MHz. The mixer in this case acts as a frequency substracter. The external signal source which is needed for this "subtraction" is again adjustable so that we can tune our "receiver" to the transmitting station. This is exactly the same way you tune in a radio or television station. Once we have a 28 MHz signal, we pass it to the demodulator section of the modem. This extracts the bit stream from the MSK signal. The bit stream is then passed to the physical interface where the physical interface software extracts the IP packet and hands it off to the IP layer for further processing.

When you are able to interconnect sites with a reasonably high speed wireless data communications link, you have a foundation for many opportunities. Not only can you carry traffic quickly, but you can carry the diversity of traffic that is afforded by using a standard computer communications protocol like TCP/IP. Also, this communications network can be very valuable in case of a local disaster when normal communications circuits are inoperative due to the disaster itself or due to overloading. A radio based network can be quickly established and plugged into the existing data network to replace downed circuits or augment overloaded ones. Industry Canada regulations allow for the use of Amateur Radio frequency allocations for emergency traffic of any sort during a declared emergency.

If you couple a versatile computer communications protocol with a wireless communications medium you can move the computer into the field. Now you can retain your connection to the applications and databases and be no longer tied to a physical connection to a communications line. If you take this a step further and make a high speed wireless connection, you can be as effective in the field as you would begin in your home or office.

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# Digital Channel Allocations for Northern California

**N C P A April 2003**

**50 MHz**

50.60-50.80 (20 kHz channels, non-specific at this time)
51.12 SCA backbone
51.14 BBS
51.16 Keyboard to Keyboard
51.18 Experimental
51.62 TCP/IP, 9600 baud
51.64-51.68 (20 kHz channels, non-specific at this time)

NOTE: On this band adjacent channel interference is harder to overcome for repeaters. NARCC requests that any new six meter permanent packet installations (such as nodes) please check with their six meter coordinator. You don't need to get a formal coordination, but they would like to be aware of your station and have an opportunity to check for possible conflicts first.

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**144 MHz**

144.31 BBS
144.33 Balloon & experimental
144.35 Keyboard to Keyboard
144.37 BBS LAN forwarding
144.39 APRS (U.S. and Canada)
144.41 Duplex, lower half (145.61 upper half, 1.2 MHz split)
144.43 TCP/IP (OK to run duplex with 145.65)
144.91 Keyboard to Keyboard (and EOC)
144.93 BBS
144.95 DX Spotting
144.97 BBS
144.99 BBS
145.01 User access
145.03 Keyboard to Keyboard
145.05 Keyboard to Keyboard
145.07 BBS
145.09 BBS
145.61 duplex, upper half (144.41 lower half)
145.63 BBS
145.65 TCP/IP 9600 bps (OK to run duplex with 144.43)
145.67 DX Spotting
145.69 BBS
145.71 9600 bps
145.73 BBS
145.75 TCP/IP
145.77 DX Spotting
146.58 DX Spotting

NOTE: Allocations from 144.31 through 144.43 are relatively close to the weak-signal sub-band–please watch your FM deviation.

**220 MHz**

219.05-219.95  100 kHz channels, Backbone
223.54  LAN
223.56  LAN
223.58  LAN, Gilory (GARLIC)
223.60  LAN, Sacramento Valley (SACVAL)
223.62  LAN, South Bay (SBAY)
223.64  TCP/IP
223.66  Keyboard to Keyboard
223.68  DX Spotting Backbone
223.70  LAN, Monterey Bay & North Coast (MRYBAY)
223.72  LAN, North Bay (NBAY)
223.74  Backbone, DX Spotting

NOTES:
• 219 channels are by coordination only. There are currently political problems with using 219-220, making them unavailable in most of northern CA.
• On 223.58, TCP/IP interlink (Sacramento) is secondary, not to interfere with node uplink.

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**440 MHz**

431.45 / 434.85  Duplex (100 kHz)
431.55 / 434.95  Duplex (100 kHz)
431.65 / 438.40  Duplex (100 kHz)
431.85 / 438.60  Duplex (100 kHz)
431.95 / 438.70  Duplex (100 kHz)
433.05  TCP/IP backbone (100 kHz)
433.15  BBS backbone (100 kHz)
433.25  DX Spotting backbone (100 kHz)
433.33  Experimental (60 kHz)
433.37  BBS, 9600 baud
433.39  DX Spotting
433.41  BBS LAN
433.43  9600 baud TCP/IP
433.45  BBS LAN
433.47  Keyboard Interlink
433.49  TCP/IP
433.51  Keyboard to Keyboard
433.53  Keyboard to Keyboard (and EOC)
433.55  BBS LAN
441.50  Any digital

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**900 MHz**

903.500  1 MHz wide, TCP/IP
904.500  1 MHz wide, TCP/IP
915.500  1 MHz wide, experimental
916.100  200 kHz wide, experimental
916.300  200 kHz wide, experimental
916.500  200 kHz wide, experimental
916.650  100 kHz wide, experimental
916.750  100 kHz wide, experimental
916.810  20 kHz wide, experimental
916.830  20 kHz wide, experimental
916.850  20 kHz wide, experimental
916.870  20 kHz wide, experimental
916.890  20 kHz wide, experimental
916.910  20 kHz wide, experimental
916.930  20 kHz wide, experimental
916.950  20 kHz wide, experimental
916.970  20 kHz wide, experimental
916.990  20 kHz wide, LAN links (Contra Costa County only)

NOTE: 900 MHz activity is on a non-interference basis to vehicle locator service. This sub-band is not considered suitable for omnidirectional systems. Use for point-to-point links only.

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**1296 MHz**

1248.500  1 MHz wide, experimental *
1249.000-1249.450   Unchannelized, experimental
1249.500  100 kHz wide, experimental
1249.600  100 kHz wide, experimental
1249.700  100 kHz wide, experimental *
1249.800  100 kHz wide, experimental*
1249.870  20 kHz wide, experimental
1249.890  20 kHz wide, DX Packet Spotting
1249.910  20 kHz wide, experimental*
1249.930  20 kHz wide, experimental*
1249.950  20 kHz wide, experimental*
1249.970  20 kHz wide, experimental*
1249.990  20 kHz wide, experimental*
1250.500  1 MHz wide, experimental
1251.500  1 MHz wide, experimental
1297.000-1298.000   Unchannelized, experimental
1298.500  1 MHz wide, experimental*
1299.000-1299.450   Unchannelized, experimental
1299.500  100 kHz wide, experimental
1299.600  100 kHz wide, experimental
1299.700  100 kHz wide, experimental*
1299.800  100 kHz wide, experimental*
1299.870  20 kHz wide, BBS LAN
1299.890  20 kHz wide, DX Packet Spotting
1299.910  20 kHz wide, BBS LAN
1299.930  20 kHz wide, experimental*
1299.950  20 kHz wide, experimental*
1299.970  20 kHz wide, experimental*
1299.990  20 kHz wide, experimental*

* Full duplex channel pairs at 50 MHz separation, example: 1249.910 ↔ 1299.910

**Definitions**

9600 BPS  Stations using 9600 baud with direct FSK (G3RUH, TAPR, etc.) modems.

Backbone  No uncoordinated stations. These channels are for specific purposes as defined by the NCPA and/or affiliated groups. These are frequencies where the various BBS, nodes, and networks forward traffic and are very high volume channels. Please use the normal user entry points of the network you want to access rather than these channels.

BBS  These frequencies are for user access to a full-service BBS. Keyboard-to-keyboard is tolerated. Please don't put high level nodes or digipeaters on these channels since they are local. A low-level direct link or node that links into a backbone on another frequency is the proper implementation.

Duplex  Simultaneous transmit and receive by a single station, including digital repeaters. Duplex channels are intended for high-volume applications. 9600 baud or higher is encouraged, but not required at this time.

DX Spotting  Northern California DX packet spotting network. No other activity should be on these channels.

EOC  Emergency Operations Center  Any group participating in or set up for emergency communications in support of appropriate government agencies.

Experimental  Anything goes except full service BBS or any 24 Hr/Day services (nodes, gateways, etc). This is where you can test new gear, programs, etc. These channels may be reassigned in the near future, so no permanent activities please.

Forwarding  same as *backbone*

Keyboard to Keyboard  Primarily chat channels. These are also the primary emergency channels, including EOC usage. No continuous high-volume activity such as full service BBS, DX Spotting, and TCP/IP servers.

Interlink  same as *backbone*

LAN  Local Area Network. BBS's are grouped into LAN's for more efficient forwarding. A LAN frequency is the forwarding channel within a LAN and to the backbone. Please do not attempt to access the BBS network on these channels.

Personal mailbox/maildrop  A BBS-like system, often running entirely within a TNC, with a small number of users that handles information of a personal, local or special-purpose nature. A mailbox is allowed on keyboard-to-keyboard channels ONLY if it does not forward with other BBSs. Mailboxes may forward with full-service BBSs on LAN channels at the discretion of the BBS SYSOP.

TCP/IP  Stations using TCP/IP protocol on top of AX.25. Some AX.25 tolerated to communicate to TCP/IP stations if a compatible p-persistence access method used.

User Access  User access to a network. This is for the next generation of packet which is expected to operate like the internet. Users would access such a network on these frequencies. The load on these channels may be rather high, like BBS channels. The activity may be any combination of BBS, keyboard, TCP/IP, or
other modes.

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**Procedure for changes**

Send requests for changes to either the frequency coordinator or the NCPA board. The frequency coordinator will then present the request to the board along with suggested assignments. The NCPA board, elected by you, the packet user, makes all assignments.

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**Misc. Info.**

Packet tends to splatter if the deviation is set too high. Please keep your deviation to less than 5 kHz.

Except for the 219-220 MHz segment, the NCPA currently does not coordinate individual stations, nodes, etc. leaving that to the special interest groups. BBS station coordination is done by the PSNC in Northern CA. DX spotting is coordinated by DXPSN. Some digital has been coordinated on auxiliary channels by NARCC.

The NCPA board conducts most of its meeting activity electronically by internet e-mail remailer, ncpa@kkn.net. As with face-to-face board meetings, interested persons are welcome. For more information about the remailer send email to
ncpa-request@kkn.net with just the command HELP in the message body, nothing in the subject, and an email message will be sent to you. Subscribe by using the command SUBSCRIBE in the message body. Subscribing to the remailer is like attending a continuous NCPA board meeting. One must subscribe before posting messages.

## Northern California Packet Association

The NCPA fosters digital communications modes of amateur radio through education, band planning, and acts as an umbrella organization for various packet special interest groups. Your annual dues helps pay for this newsletter and other educational materials activities. If you might be interested in getting more involved, please let us know.

Call: ____________________ Home BBS: __________ e-mail: _______________________________

Name: ____________________________ Address: ____________________________________________

City: ______________________________ State: ____ Zip + 4: __________ Phone: _______________

☐ New Membership ☐ Renewal ☐ Change of Address ☐ I'm an ARRL Member
☐ One year: $10 ☐ Two Years: $20 ☐ Three years: $30
(make checks payable to NCPA)

Please indicate your area(s) of interest:
☐ BBS SysOp ☐ BBS User ☐ APRS ☐ NET/ROM ☐ TCP/IP ☐ High-speed packet
☐ DX Packet Spotting Network ☐ Keyboard to Keyboard ☐ FCC/legal issues ☐ Other:

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**NCPA** *Downlink*

**Northern California Packet Association**
**PO BOX K**
**Sunnyvale CA 94087**

**First Class**