NCPA Downlink

The Official Journal of the Northern California Packet Association
Serving Amateur Radio Digital Communications in Northern California

Spring, 2001 **Issue number 27** **$2.50**

Digital Radio in the New Millenium -- Some Thoughts on Where We Are, and Where We're Going.

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December 2000
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The dawn of the 20th century saw tremendous technological change. Within a decade or two either side of 1900, the telephone, automobile, airplane, and wireless all came into widespread use. All these developments served to bring people closer together, making the world a smaller place.

When future pundits examine the beginning of the 21st century, I think they will find that similarly profound changes took place around 2000. In particular, they will see that technology was creating an even smaller world, one bound together by digital communications. The Internet today, as big as it is, is only a working model of the digitally connected world we'll see in another few years. And, while today wireless networking is just coming into its own, untethered digital systems will become a larger and larger part of the interconnected world of the future.

In short, the technology transformation going on right now is the shift from a wired analog world to a wireless digital one. And hams ought to be right in the middle of it. Are we?

It's easy to say that amateur radio is not keeping up with the times--after nearly 20 years, most packet activity is still at 1200 bps while the typical telephone modem now claims 56 kbps, and in many areas wideband access at hundreds of kilobits per second is available. As a result, "traditional" packet activity like BBS operation is disappearing in many parts of the world. From that, many folks assume that "packet is dead." More generally, there seems to be a common view that ham radio has lost its ability to innovate. I disagree with both these perceptions.

We *are* continuing to innovate, and we have at least two windows of opportunity for important advances that will keep amateur radio meaningful for a long time to come. One of them involves better application of things we already do, while the second puts us on the leading edge of technical development. The rest of this article introduces these areas where I think we can make a real difference if we move quickly.

And we *must* move quickly, because time is short. The commercial world will pass us by if we decide to think about these things for a few years before doing them.

Portable Wireless Data Networks

We're already heavily involved in an activity that the commercial world is just starting to exploit: portable and mobile wireless data communications. I think we have a window, a short window of perhaps 18 months, to integrate the technologies we've already developed--first and foremost, APRS, but also our TCP/IP networks--into tools that are useful to the community at large. In the U.S., one of amateur radio's reasons for existence is to provide public service, and integration of APRS and other data tools into our toolkit could add a lot of

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value. Let me point out just a few of the possible applications.

First, there's traditional APRS activity. Tactical position information is neat, and weather stations provide valuable information (a fact which the US National Weather Service is starting notice). However, the messaging capability in APRS is a tool that we need to sell as well. APRS messaging is as capable as the mobile phone messaging systems that are starting to appear. Short, real-time messages from portable devices can be very valuable in an emergency situation. In addition, the "tiny web pages" that APRS'rs are now using can convey information as usefully--if not quite as graphically--as any of the portable web devices.

Our capabilities aren't limited to APRS. There are public service applications where we need to move more data than the APRS model supports. We could be doing much more with our existing packet radio technology, particularly TCP/IP applications, than we are. We could be providing portable (laptop-based) systems with email, conferencing, and even modest graphics capabilities, at a very reasonable cost.

This isn't meant to be a how-to guide, but consider this. We have all the pieces necessary to build portable 9600 baud, TCP/IP capable systems, using a web browser as the interface, for perhaps $300 each. Start with a Tekk radio that will give you a couple of watts at UHF, and handle 9600 baud nicely, for less than $150 (or convert surplus UHF HTs for even less). Add a Baycom 9600 baud modem that attaches to a computer parallel port and costs less than $100. Use SV2AGW's Windows 98 network driver software, which costs $28 to register, and get rid of the excuse that TCP/IP requires a user-hostile program like JNOS. Or, run Linux, which supports the Baycom modem directly and lets your station be a network service provider, rather than simply a user.

Add a second-hand laptop and a UHF yagi antenna, and you have a complete portable packet station that can do email, multi-user conferencing, and even web browsing using a familiar graphical interface; with the SV2AGW software, you can use the same web browser, email client, etc. that you use when on-line. To provide solid coverage for those low power radios, you might want to build a UHF digital repeater (which can be a surprisingly low cost project).

Do you think your local emergency group could be convinced that a capability like this would be a good idea? It may take some work to integrate these stations most effectively into emergency communications plans created with only voice modes in mind, but the end result could be drastically improved communication reliability during a crisis. And, by the way, when there's no emergency going on, these systems could be a lot of fun to play with. How about providing a local "chat" server, or even RF-based web pages, for local users?

Better use of APRS and portable data terminals in public service communications is an exercise in

The NCPA Downlink is published quarterly by the Northern California Packet Association, P0 Box K, Sunnyvale CA 94087, for the entertainment and education of amateur Radio operators using digital modes, and those with an interest in them. A one-year membership in the NCPA, including a subscription to the NCPA Downlink, is $10.00 in the U.S. and its possessions.

The digital band plan as well as other information about the NCPA, are available on the Web at: http://www.n0ary.org/ncpa

The NCPA Board of Directors meets electronically in order to transact association business and meet with members and interested amateurs. The address for the board mailing list is: ncpa@qth.net. E-mail to majordomo@qth.net with the text "subscribe ncpa" in the body of the message to subscribe to the discussions.

systems integration using technology that's already available. The challenge is much more political than technical; it's a matter of making packet radio visible and available to the other aspects of our hobby.

At present, the APRS network in the U.S. has coverage that exceeds any of the commercial systems, and we have the distinct advantage of being able to change our network very quickly to adapt to communication emergencies. But we only have a short window of opportunity. The commercial services are out there and they're growing. They have public awareness that we don't. Web-enabled mobile phones and wireless devices like Palm-Pilots are quickly entering the marketplace and the public eye. We need to move quickly to make APRS and other packet operations an integral part of emergency communications planning before our capabilities are overtaken by the commercial telecom providers.

Software Defined Radios

Our second window of opportunity is a bit more futuristic. It moves us away from packet radio and into the broad area of digital radio. The buzzword is "Software Defined Radio," or "SDR." In short, a SDR is a radio that replaces most of the analog components with digital signal processing ("DSP"). DSP is the use of special purpose CPUs to process signals in the digital domain. DSP can implement frequency conversion, filtering, modulation, and demodulation in software. Because these functions are defined by software, not hardware, DSP designs are extraordinarily flexible.

We can't do it now (at least not economically), but the ultimate SDR vision is a radio in which the only analog components are the power amplifier and receive preamp. Those devices connect to high-speed digital-to-analog and analog-to-digital ICs and all the rest of the stages are done by DSP. The flexibility of such a radio is enormous. It can operate on any frequency within its design range, using any bandwidth and any modulation scheme, with no hardware changes. The radio is defined by its software, and to change its characteristics, you simply change the software.

Why are SDRs important to ham radio? Many hams complain that experimentation is no longer possible because the technology needed to be on the leading edge, such as tiny surface mount components with hundreds of leads, is too difficult for most amateurs to work with, and too expensive to buy for experimental purposes (blowing up a $100 IC creates a different feeling than smoking a resistor!). There's also a very real availability problem for "old fashioned" components with wire leads. And, technical information on the special-purpose chips that have replaced traditional components may be very hard to come by.

These problems combine to make it more difficult for hams to do leading edge hardware products. The SDR offers a different way for us to view experimentation. A SDR with an open design and open software can provide a perfect platform for ham tinkering.

Picture a SDR with a frequency range of 10 kHz to 30 MHz (we can do better than that, but let's keep it simple). With a box like that sitting in your shack, and some development software running on your PC, there's no HF mode that's beyond your reach. Moving from AM on 160 M to digital voice with with forward error correction on 10 M requires no rebuilding, just reprogramming.

With SDRs, our emphasis shifts from hardware to software, and we use compilers rather than soldering irons, but we are back in the business of "advancing the radio art" through experimentation. It's a paradigm shift, and it may be uncomfortable, but it's one we'll have to make sooner or later. The commercial world is moving toward SDRs and there's no reason we shouldn't be moving with them. In fact, we have a window of opportunity to be on a par with the commercial interests. SDRs are new and the commercial world hasn't figured out just what the standards should be. If we move quickly, we can help *create* the standards.

Just as open source software like Linux has shown that hackers can compete on even terms with the big boys, a ham SDR platform can let us go eye-to-eye with commercial radio developers. Clever programming doesn't require multi-million dollar research facilities.

Now, we can't do the ultimate SDR yet. Components that operate at VHF and even HF frequencies are still far beyond the ham budget. However, those prices are coming down, and in the meantime, we can get our feet wet with a hybrid SDR that resembles a traditional radio down to the last IF in the receiver and the modulator in the transmitter. The "back end" of the radio is replaced by low cost DSP components that are available today at reasonable prices.

In fact, a computer sound card can be the heart of a SDR designed for HF narrow-band modes like PSK31; QST published an article about such a beast

Are You Still a NCPA Member?

Please check the mailing label...Has your membership expired? If so, why not renew your membership now while you're thinking about it? (There's a form on the back cover.)

If your membership expired in 1999, then this will be your last *Downlink*!

Memberships have been extended to allow for the fact that the *Downlink* didn't come out quarterly in the past, but this is it for those with 1999 expirations. If you are in that category, but feel you should have more issues coming anyway, please contact us.

last summer. A slightly higher-performance DSP engine can handle wider bandwidth modes like SSB, AM, and FM. The DSP-10 2 M radio project, also published in QST, shows an example of this. These projects are just the start of what we can do with SDRs; all we need is to get the hardware engines and software tools out to the experimenter community.

TAPR's Role

What's TAPR doing to support these two initiatives, to help us take advantage of the windows of opportunity before us?

We've been supporting wireless networking for a long time. TAPR is the primary meeting ground of the APRS community and we will continue to support advances in APRS. We will also support development of the portable network terminal concept I described, although, frankly, the challenges we face with this project are political, organizational, and operational, not technical.

On the SDR front, TAPR has committed to help make SDR kits available to the ham community and to support those who want to develop code to run on these engines. We hope to announce our first kit shortly and we already host a DSP mailing list where coders have been discussing software modem design techniques for quite a while. TAPR sees the Software Defined Radio as a perfect opportunity for our "enabling technology" philosophy -- by making general purpose SDR engines, and the tools to program them, available, we enable hams to once again become experimenters on the leading edge of communications technology.

TAPR is a membership organization; our ideas come from people who are passionate about radio. We help those people turn their ideas into products that benefit ham radio. What are **your** ideas? We'd love to hear from you, and if you're as excited about the future of ham radio as we are, we'd love to have you as a TAPR member.

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Packet Sysops of Northern California Packet Bulletin Board Systems

November 2000

Call-SID	Location	User Ports
WH6IO	Benica	144.99, 145.71&+, 145.75&, 433.43&+
N6EEG	Berkeley	144.97
KE6I	Berkeley	145.01&, 433.43&
N2THD-1	Citrus Heights	145.07, 441.50
WA6YLB	Exeter	145.69
N6QMY-1*	Fremont	144.31, 441.50
N6CKV	Gilroy	144.99
N6LDL	Los Gatos	144.97, 145.71&, 441.50
WA6NWE-1	North Highlands	144.93, 145.09, 145.75, 441.50
KD6DG	Redding	145.09
WD6CMU	Richmond	144.97
W6CUS-1	Richmond	145.63
N0ARY-1	San Jose	144.93, 433.37&
KD6JZZ	Sonora	144.97
WA6EWV-1	South Lake Tahoe	144.97
W6YX-9	Stanford Univ	145.75+
W6SF	Stockton	144.99
K6MFV	Walnut Creek	144.31, 145.71&+
K7WWA*	Willits	144.31*, 145.69*
KE6LW-1	Yuba City	144.99

Keys:
& = 9600 Baud Port
+ = TCP/IP Port
* = Currently Inactive

President's Message

Gary Mitchell, WB6YRU

In the lead article of this issue, TAPR's President John N6UR summarizes two interesting aspects of future amateur digital communications. Personally, I especially like the software radio.

John mentions some of the problems we are now having, particularly dwindling packet activity.. Like many others (including me), his suggested solutions involve technology. This is all well and good, but lately I'm becoming convinced this sort of thing is only half of the solution.

As I look around at packet right now (at least in this region), I don't see a lack of technical possibilities and things to experiment on. The problem is lack of enthusiasm and desire to do more on the part of us packeters. Those that do the experimenting and tinkering don't seem to be playing with packet much these days.

There are BBS's in this region with 9600 baud user ports that go almost unused while activity on the 1200 baud ports continue. Years ago, this was forgivable due to the cost and trouble involved in anything faster than 2400 or 4800 baud. However, that's no longer the case. There are even programs available that will make the sound card in your PC operate like a TNC–up to 9600 baud. No expensive 9600 baud TNC is needed.

Even this doesn't seem to be

enough. The last frequency channel the NCPA allocated was requested for only 1200 baud. At the time I tried to encourage usage of 9600 baud, but they simply weren't interested. The excuse was that 1200 baud equipment was easier to get and they already had some of it.

We could put stuff together to demonstrate the "gee whiz" factor of some of these things (such as at Pacificon), but I seriously doubt that will help much.

What we need is something equivalent to "the killer app" that software people speak of (killer application–a "must have" program that causes sales of computers or support software to sky-rocket). In other words, we need something to do, something fun and interesting that uses these new technologies and methods, rather than trying to sell the technologies and methods themselves.

Before most people had internet access, packet's killer app was the BBS network's ability to pass personal messages and bulletins almost anywhere. Today, we have e-mail and usenet groups on the internet that do these functions much better. We need something else, something that isn't available or practical on the internet.

Recently I asked a few packet people what would they like to see from packet BBS's? The only real answer was better internet access and/or a web browser user interface.

The web browser interface is do-able. However, the problem with internet access is the fact that amateurs are restricted as to content that may be transmitted. The content restrictions we work under need to be eased, in my opinion...but I digress.

Most of the BBS sysop's didn't seem to think much of this idea. The most common objection is that they don't want to become a free internet service provider. And that is a good point. Integrating the internet into packet is a worth while effort, but we don't want to compete with the internet.

We need something better. So, let's put our heads together and do a little brainstorming! We already have APRS and DX spotting, what else? What could amateur digital communications do that would make people say "ooh, I've got to get one of those!"? We need a killer app for packet! Let's hear your ideas and comments.

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News from the ARRL

From *The ARRL Letter*, March 16, 2001

{2413-2418 MHz is supposed to be digital. – Ed.}

FCC DENIES LA COUNTY 2.4-GHZ APPLICATION

Following objections from the ARRL, AMSAT and others, the FCC has turned down an application from Los Angeles County, California, for an experimental license permitting airborne microwave TV downlinks (TVDL) in the 2402-2448 MHz range. The FCC also canceled an experimental license grant to the City of Los Angeles to operate a TV downlink system in same band. Amateurs have a primary domestic allocation at 2402-2417 MHz and a secondary allocation in the rest of the affected band.

"Experimental licenses are not substitutes for regular radiocommunication service licenses," said Charles Iseman, deputy chief of the Electromagnetic Compatibility Division in the FCC's Office of Engineering and Technology. OET issues all experimental licenses.

The ARRL, AMSAT and the Amateur Television Network as well as ARRL members Art McBride, KC6UQH, and Thomas O'Hara, W6ORG, filed informal objections to the County's application. The League, AMSAT and ATN also had objected to the City's experimental grant. The FCC gave the City until December 1 to terminate its operation and reserved the right to accelerate the cancellation date if harmful interference occurs.

The LA County proposal, filed in August 1999, sought FCC authorization to develop a TVDL system on four 2.4 GHz channels for use aboard sheriff's and fire department airborne units. The FCC granted the City's WB2XEN experimental license based on a similar submittal. The FCC said other public safety agencies in Southern California, including Long Beach, Glendale and Burbank, plan to deploy similar airborne units.

In protesting the County's plan, the ARRL called the application a "foot in the door" toward gaining a permanent berth in the 2.4-GHz band. The County and the City already are authorized to operate TVDL systems under Part 90 rules in the 2.450-2.483.5-GHz band, but both told the FCC that they had experienced coordination and interference problems and sought the experimental TVDL authorization as a result.

In light of the denial and the cancellation, the FCC did not address potential interference issues raised by the objectors. Copies of Iseman's letters are available on the ARRL Web site, http://www.arrl.org/news/stories/2001/03/15/2/fccletters.pdf.

ARRL 160-METER BAND PLAN COMMITTEE READY FOR INPUT

ARRL President Jim Haynie, W5JBP, has selected five amateurs to serve on the ad hoc 160-Meter Band Plan Committee. The panel is open for input from the amateur community regarding the current band plan for "Top Band" and recommendations for changes. The ARRL Board of Directors approved formation of the committee at its annual meeting in January.

"With the ever-increasing activity on 160, it is time to revisit the band plan," said ARRL Delta Division Director Rick Roderick, K5UR, who was named to chair the committee.

Also asked to serve on the panel were ARRL New England Director Tom Frenaye, K1KI; ARRL Dakota Division Director Emeritus Tod Olson, K0TO; Jeff Briggs, K1ZM, and Bill Tippett, W4ZV. All of the appointees are veteran amateurs and familiar with 160 meters and the issues facing the band. Briggs, a perennial Top Band contester and DXer, literally wrote the book on

160 meters, DXing on the Edge--the Thrill of 160 Meters. Tippett has more than 300 DXCC entities to his credit on 160.

ARRL Membership Services Manager Wayne Mills, N7NG, will serve as Headquarters staff liaison with the committee.

Unlike the other HF bands, 160 meters never has been divided by the FCC into mode-specific subbands. Most amateur transceivers didn't even begin to include the band until the influx of Japanese imports began in the 1970s. As a result of that and the elimination of the HF LORAN system, 160 meters has grown in popularity over the past couple of decades. Today, many modes--CW, SSB, AM, RTTY and other digital--coexist on Top Band, although not always harmoniously. Most operation also tends to cluster on the lower 100 kHz of the band, and the lines between which modes operate where are becoming increasingly blurred.

Roderick says the band plan committee is open for comments "from all parties--the digital folks, DXers, ragchewers, anyone." The e-mail address for comments is 160-BANDPLAN@ arrl.org. All comments must include a subject line. The committee plans to report back to the ARRL Board of Directors with its recommendations at the Board's July meeting.

All ARRL band plans are on the Web, http://www.arrl.org/FandES/field/regulations/bandplan.html .

ARRL SEEKS TO EXPAND AMATEUR ACCESS TO 216-220 MHz

{The NCPA is also working on this basic problem, although not this specifically. --Ed.}

The ARRL has suggested that the FCC expand the secondary amateur allocation at 219-220 MHz to provide hams with access to the entire 216-220 MHz band. The League commented this month in response to a Notice of Proposed Rule Making, ET Docket 00-221, that proposes to reallocate 27 MHz of spectrum in various bands, including 216-220 MHz, from government to non-government use.

In general, the FCC seeks to allocate the entire 216-220 MHz band to the Fixed and Mobile services on a primary basis. At 219-220 MHz, Amateur Radio now is secondary to the Automated Maritime Telecommunications System (AMTS). Within the 1-MHz of spectrum, amateurs may install and operate point-to-point digital message forwarding systems, including inter-city packet backbones, but only under strict limitations.

DX Spotting Nodes

June 2000

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 area
	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
Mountain View	K6LLK	DXMV	144.950	Mountain View, San Jose area
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 (24OO baud)	
Rio Linda	K6NP	DXRL	144.950	Sacramento, Woodland, Davis

Bob Vallio - W6RGG wsixrgg@crl.com

While the FCC has promised to protect AMTS and other operations from new interference, it extended no such assurances to amateur operations at 219-220 MHz. In its comments, the ARRL expressed fears that additional co-primary users "will essentially foreclose what limited opportunities there are now for amateurs to make use of the 219-220 MHz segment."

The League suggested that in the face of such potential constraints at 219-220 MHz, permitting amateur access to the entire 216-220 MHz band on a non-interference basis would be one means to accommodate Amateur Radio operations in that portion of the spectrum. Such a move would, the ARRL said, "provide at least some opportunity for amateurs to engineer fixed links into the band, which would not be possible in the 219-220 MHz segment alone."

Last month, in comments filed in PR Docket 92-257, the ARRL suggested letting amateurs submit computer-generated field strength contours that demonstrate a lack of interference potential to AMTS sites, in lieu of having to get written permission. In this proceeding, the ARRL further suggested that amateurs who proposed to operate in the 216-220 MHz band be allowed to used "fixed-distance separations" in lieu of the present consent requirements, as a means to demonstrate the absence of interference potential to AMTS and other co-primary users.

A copy of the ARRL's comments in ET Docket 00-221 is available on the ARRL Web site, http://www.arrl.org/announce/regulatory/et00-221/index.html .

"BOING-BOING" INTRUDER LIKELY A CODAR INSTALLATION

The ARRL Monitoring System will formally ask the FCC to monitor yet another intruding signal, this time on the 12 meter amateur band. The widely reported signal sounds a bit like a tightly wound, noisy spring being repeatedly compressed and released. It's believed to be coming from a surface-wave radar installation, possibly in Central or South America.

"It sounds like someone playing with a really noisy spring, or a very poorly tuned guitar string," says ARRL Monitoring System Administrator Brennan Price, N4QX. "This signal is also unique in that it precisely occupies the entire 12 meter band, from 24,890 to 24,990 kHz, with the same pitch and tempo throughout the band."

While the signal does not appear to be overly disruptive to amateur communications, it is almost certainly an intruder. "The 12 meter band is allocated to amateurs on an exclusive basis worldwide," Price says. "This is not one of those instances where the observed station has as much right to use the frequency as United States amateurs; any non-amateur signal on 12 is an intruder."

Informal discussions with professional monitors suggest that the rough pulses--about two per second in frequency--are characteristic of a CODAR (Coastal Ocean Dynamics Applications Radar) transmitter. CODAR is a specific type of HF radar used to map ocean surface currents in coastal zones.

An overview of CODAR theory and applications is available on the National Oceanic and Atmospheric Administration Web site, http://www1.etl.noaa.gov/codar/codar.htm .

NEW DISTANCE RECORD SET ON 76 GHz IN PALO ALTO

A new world distance record on 76 GHz is being claimed by Palo Alto Amateur Radio Association member Bob Johnson, KF6KVG, and his partner, Will Jensby, W0EOM, of the 50MHz and Up Group. The new claimed record for 76 GHz was set February 1. Johnson was located southwest of San Jose, California, on Mount Loma Prieta running 1mW to a 12-inch dish antenna. Jensby was located on Mount Vaca near Vacaville running 5 mW to an 18-inch dish. The total distance covered was 145 kilometers based on the "center of grid square to center of grid square" measurement approach.--adapted from PAARAgraphs March 2001

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Board of Directors Electronic Meeting

Excerpts of the NCPA board remailer traffic, February 13, 2001 through April 26, 2001. Compiled by Gary Mitchell WB6YRU (full text of traffic is available).

March 21, 2001
Allan W6MEO:
Will appreciate if someone can steer me to a guide showing the accepted standard channel spacing for FM voice repeaters above 30 MHz, for Northern California. Likewise SoCA.

WB6YRU:
Try the ARRL Repeater Directory. For Northern CA, NARCC is the repeater coordinator (http://www.narcc.org).

W6MEO:
I was just told about another one, even better: www.sharkk.com

March 30, 2001
Gary WB6YRU:
The next Downlink will come out later in April.
Articles or comments are welcome.

April 23, 2001
Dave N6UOW:

Pacificon 2001 will be October 19-21, back at the Condord Sheraton, near the airport.

The NCPA is planning to have a booth (table) with information and perhaps some demo's.
We'll also probably have our annual meeting at Pacificon again too.

If anyone has any suggestions about what we can/should be demonstrating, or what information we should hand out, please let us know.

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Northern California Packet Band Plan

N C P A March 2001

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 NARCC 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
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.

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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

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
433.53 Keyboard
433.55 BBS LAN
433.57 - 433.70 (20 kHz channels non-specific at this time)
433.75 / 438.45 Duplex (100 kHz)
433.85 / 438.55 Duplex (100 kHz)
433.95 / 438.65 Duplex (100 kHz)
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.

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.

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. No high-volume activity such as full service BBS, DX Spotting, TCP/IP, etc.

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.

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.

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 bee coordinated on auxiliary channels by NARCC.

The NCPA board conducts most of its meeting activity electronically by internet e-mail remailer, ncpa@qth.net. As with face-to-face board meetings, interested persons are welcome. Subscribe to the remailer by sending e-mail to majordomo@qth.net with "subscribe ncpa" as the message. Subscribing to the remailer is like attending a continuous NCPA board meeting.

Overall Band Plan in Northern California

ten meters and above **November 2000**

Notes:
This band plan is a joint effort by NARCC (www.narcc.org) and the NCPA (www.n0ary.org/ncpa). As of this printing, ten meters through 70 cm are pretty much settled. The bands 33 cm and above are in progress. There is still some question regarding the ATV channel at 70 cm. NARCC is proposing it be moved up slightly and be made simplex. It's not yet clear what they intend to do about existing ATV repeaters.

Individual channels are 20 kHz wide, unless otherwise noted.
Simplex – FM voice
RC – Remote Control

Other sources:
Weak Signal: WSWSS (Wester States Weak Signal Society) www.wswss.org.
Satellites: AMSAT www.amsat.org.
ARRL: www.arrl.org.

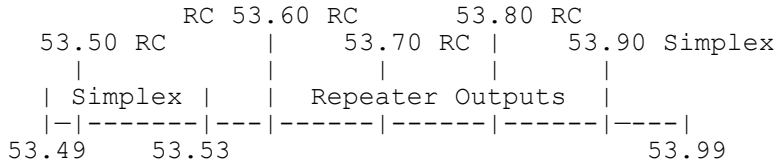
TEN METERS ==========

```
                                    SSTV 28.68  29.0   29.2
                                           |      |- AM -|
  | CW          | CW and  | CW & beacon |    |      |      |
  | Weak Signal | Digital | Weak Signal |  Phone (no FM)   |
  |-------------|---------|-------------|---|------|------|-|
28.0          28.07     28.190        28.3               29.3


      National simplex 29.60
                        |
              | Repeater | Repeater |
  | Satellite | Inputs   | Outputs  |
  |-----------|----------|----------|
29.30       29.51      29.60      29.70
```

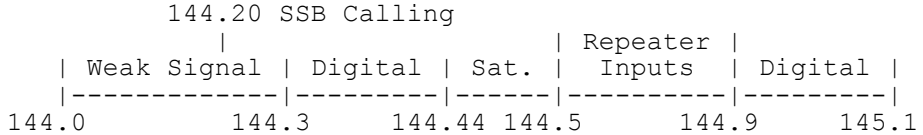
Note: Automatic beacons are limited to 28.20 - 28.30

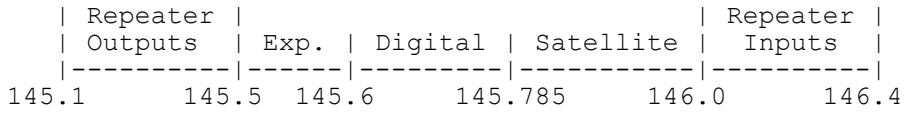
SIX METERS ==========

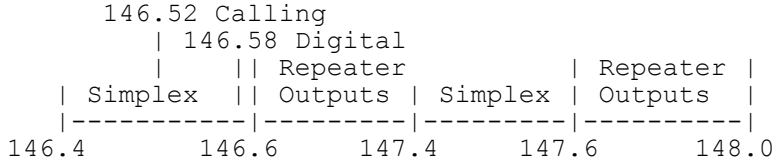
```
      50.12 SSB Calling
        |        50.40 AM Calling
        |         |                 | Remote  |  Weak  |
  | Weak Signal | All Mode | Digital | Control | Signal | Digital |
  |-----|-------|--|-------|---------|---------|--------|---------|
50.0          50.3       50.6      50.8      51.0     51.11     51.19


  | Repeater |                   | Repeater |         | Repeater |
  |  Inputs  | Simplex | Digital | Outputs  | Simplex |  Inputs  |
  |----------|---------|---------|----------|---------|----------|
51.19      51.49     51.61     51.69      51.99     52.05      52.49


                                  RC 53.20       RC 53.40
                             RC 53.10  |  RC 53.30    |
           | Repeater |           |    |       |      |
  | Simplex | Outputs  | Simplex | |  Repeater Inputs  |
  |---------|----------|---------|-|----|-------|------|---|
52.49     52.55      52.99     53.03                      53.49
```



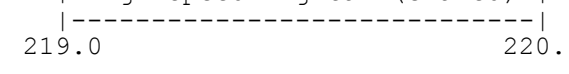
TWO METERS ==========

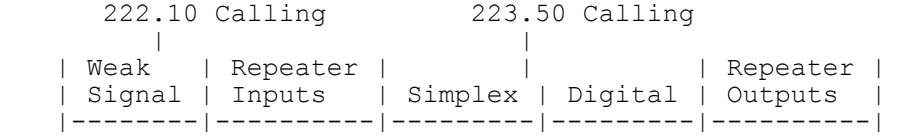




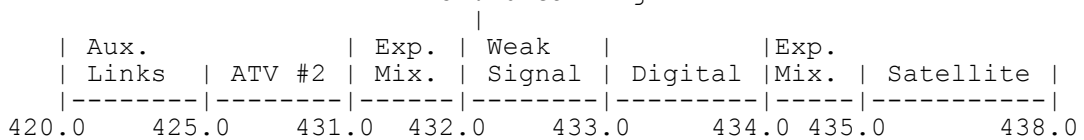


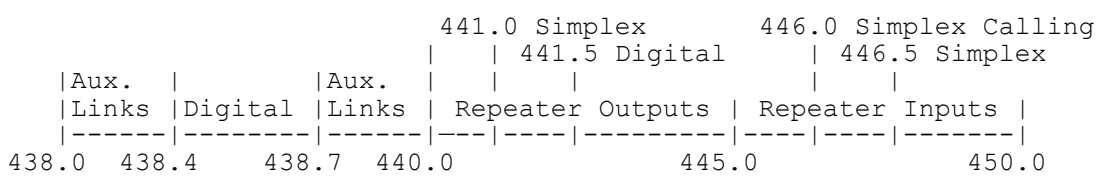
1.25 METERS ==========





70 cm ==========





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:

NCPA *Downlink*

Northern California Packet Association
PO BOX K
Sunnyvale CA 94087

First Class