The following was sent to the NARCC public email reflector on Thursday, April 2nd, 2009.

As everyone on this list is probably already aware, there will be a plan presented at the meeting this Saturday (April 4th) for narrow-banding the 144/145 repeater sub-band.

In an effort to be able to understand the effect of any proposed option, Santa Clara County ARES/RACES recently conducted a survey of 2m radios in use throughout Santa Clara County (and part of Alameda County). The purpose of the survey was to determine what types of radios are in use (in the 2m band) and what their capabilities are with respect to narrow-band FM. The idea was to gather sufficient data to allow any proposed narrow-banding plan to be evaluated according to factual data from the actual radios is current use, rather than generalized trends or assumptions. While Santa Clara County is just one county covered by the Northern California band plan, the expectation is that the sample size would be large enough to be significant and likely similar to other counties in Northern California.

We have been told by the NARCC board that discussion of the plan will be limited to 30 minutes and there will be no time for presentations of such data at the NARCC meeting. Therefore, a summary of the results is included below so that people have the information available to them when making their decision on Saturday. In the following paragraphs, I'll cover the survey methodology, research and testing processes, and a brief summary of the results. This is followed by the conclusions we were able to draw. If you are not interested in the details of the process, you can skip straight to the conclusions section.

Survey Methodology:

The survey request was sent to all ARES/RACES members in Santa Clara County via their city Emergency Coordinators. Individuals were asked to report back the make and model of the 2m radios that they currently use on a regular basis. We specifically requested that people NOT include collectors' items or radios that they do not regularly use. Cities also reported the radios in use in their Emergency Operations Centers, communications trailers, etc. These are regularly used during drills and would be the center of communications traffic during emergencies.

Total number of radios reported = 966
Total number of models reported = 251

Research:

We started with the most popular models and worked our way down the list, researching the specifications for any model that was reported at least twice. A variety of capabilities related to narrow-banding were researched, including: 12.5 kHz tuning step size, CTCSS decode, receiver selectivity, transmitter frequency stability and, most importantly, transmitter deviation.

Total number of models researched = 115
Total number of radios represented by the researched models = 830
Percentage of reported radios that were researched = 86% (830/966)

In other words, the research covered the vast majority of radios in use.

Testing:

We also conducted testing using service monitors and other instruments on 15 different models, including 6 of the top 7 models. Testing included transmit deviation measurements as well as a series of tests to determine the power level required for an adjacent signal to interfere with the primary signal.

Summary of Results:
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1) 373 (45%) of the researched radios do not have the ability to transmit at narrow (+/- 2.5 kHz) deviation
2) Of the radios that COULD switch to narrow transmit deviation, most used a global or per band option located in the menu instead of a front panel button, and most do not save the narrow mode with the individual frequency memory. This means that users who wish to QSY between repeaters in different parts of the band or between repeaters and simplex frequencies would be required to execute a somewhat complicated (depending on the model) set of button pushes in order to tune to the new frequency and switch on or off narrow deviation mode. This would not be possible while driving or performing other functions and would be, for all intents and purposes, impractical.
3) Of the radios that COULD switch to narrow transmit deviation, only a few (about 10%) also narrowed their receiver selectivity. This means that 90% of the radios will be more susceptible to interference from the adjacent channel than they currently are at 20 kHz spacing. Therefore, the vast majority of radios would experience more false squelch breaks (if CTCSS decode is not used) and would be more likely to get bleed-through from the adjacent channel.
4) Bleed through at 15 kHz spacing and 5 kHz deviation occurred with as little as 3.5 – 9.5 dB difference in signal strength for 3 of the top 4 radios reported. In other words, if you are tuned to one channel, and if the adjacent channel is 3.5 to 9.5 dB stronger, the adjacent channel will start to audibly bleed through on 3 of the top 4 radios reported. For other radios with better selectivity, the adjacent channel signal strength needed to cause bleed-through was much higher, on the order of 20 dB. Bleed through did not occur at 20 kHz spacing.
5) If the adjacent channel is strong enough, it can even capture the receiver of the user radio. At 15 kHz spacing, capture occurred on some radios if the adjacent channel was more than 20 dB stronger. At 20 kHz channel spacing, capture did not occur.
6) Radios that COULD narrow their receiver passband when placed in “NFM” (narrow FM) mode experienced no bleed through at 12.5 kHz spacing and 2.5 kHz deviation. This capability exists in only about 10% of the radios researched (85/830).
7) Tone squelch or CTCSS decode was available as a standard feature on 679 of the 830 radios researched (82%). It was listed as an option on another 95 or the 830 radios researched (11%). So it is available either as a standard feature or as an option for 93% of the radios researched.
8) 12.5 kHz tuning step size was available on 771 of the 830 radios researched (93%). However, this was often a setting available in the menu and applied either globally or per band (or the scope wasn’t clear from the documentation). Therefore, similar to setting narrow mode deviation, selecting 12.5 kHz spacing could be problematic for many radios if the whole band is not using the same spacing. More detailed research and individual experimentation would be required to determine the percentage of radios that can set 12.5 kHz spacing per memory.
9) There were 13 D-star-capable radios reported (13 of 966 radios reported or 1%). The one D-star radio tested had excellent selectivity and suffered no bleed-through during any of the tests.

Conclusions and observations regarding 12.5 kHz spacing:

Based on the review of radio specifications and the testing performed, we can conclude that converting the 144/145 repeater sub-band to 12.5 kHz spacing (and 2.5 kHz deviation) would have the following consequences:
1a) Almost HALF (45%) of the radios currently in use can not operate with 12.5 kHz spacing
1b) Interference in the 144/145 repeater sub-band would be significant due to people forgetting to turn ON narrow deviation; it would also create significant reception problems in the rest of the band due to people forgetting to turn OFF narrow-band deviation.

We also make the following observations regarding 12.5 kHz spacing:
1c) Replacement (or modification) of half of the radios in use today would be prohibitively expensive. Replacing radios also often requires replacing battery packs, chargers, interface cabling, headset adapters, TNC adapters, etc. Some estimates indicate that the cost could easily exceed $100,000 just for active Santa Clara County ARES/RACES participants. The cost for others in the County, as well as the rest of Northern California, has not been determined.
1c) Modification of radios to accommodate 2.5 kHz deviation, if possible, would need to be done in a way that the deviation level is selectable. This is because the rest of the band does not use narrow FM deviation and the rest of the country is not subject to the Northern California band plan
1d) Northern California would become an “island,” because almost half of the hams from anywhere else who might relocate here or might be called in to help with a disaster would likely have radios which could not be used.

Conclusions and observations regarding 15 kHz spacing:

Based on the review of radio specifications and the testing performed, we can conclude that converting the 144/145 repeater sub-band to 15 kHz spacing would have the following consequences:
2a) More interference in the form of audible bleed-through would be present at 15 kHz spacing than at 20 kHz spacing. For some radios, bleed through occurs even if the adjacent signal is only moderately stronger (3.5 to 9.5 dB).

We also make the following observations regarding 15 kHz spacing:
2b) Limiting repeaters to 4 kHz deviation will reduce or avoid bleed from the stronger repeater signals
2c) requesting that all repeaters output CTCSS tones and arranging the tones such that repeaters on adjacent channels do not use the same tone will avoid false squelch breaks
2d) ensuring that repeaters on adjacent channels do not have overlapping coverage areas will reduce the likelihood of a strong repeater output on one channel from bleeding through or even capturing the receiver which is tuned to an adjacent channel.

Observations regarding any change to channel spacing:

Repeater owners have commented that it could take up to a few weeks to make the necessary changes to their equipment, especially if they must send off components for service. Since ARES/RACES uses many repeaters simultaneously for any given incident, the conversion of the repeater sub-band channel spacing will likely disrupt ARES/RACES operations for at least a month, perhaps two or three – depending on how quickly repeaters are moved. The main issue is updating documentation, communicating the changes, and coordinating the move of hundreds of users, each of whom needs to reprogram multiple frequencies. This is not an argument for or

against adjusting the channel spacing, but a simple reality that must be considered when/if planning the conversion.

We are hopeful that the above data from actual radios in use today will be helpful to members who are faced with placing a vote on any proposal for narrow-banding.

73,
Michael - N6MEF
Representing Santa Clara County ARES/RACES