DIGITAL COMMUNICATIONS

(part 7)

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Disclaimer:

These are my comments on digital communications and are not necessarily all there is to know on the subject. As with everything computer related – there are at least six ways to do the same thing. Given this caveat, let me say this is opinion and not the complete story. I only relate to you my experience of 5 or more years using digital modes and as SATERN International Digital Net Manager to give you the benefit of my experience. I will leave the rest for you to research as you see fit.

We have defined a few terms and looked at software for digital communication. There seems to be a need to also review some practical operating issues as well.

One of the first issues is this – *Which do you use; the rig dial frequency or the actual center frequency when specifying a net or QSO?*

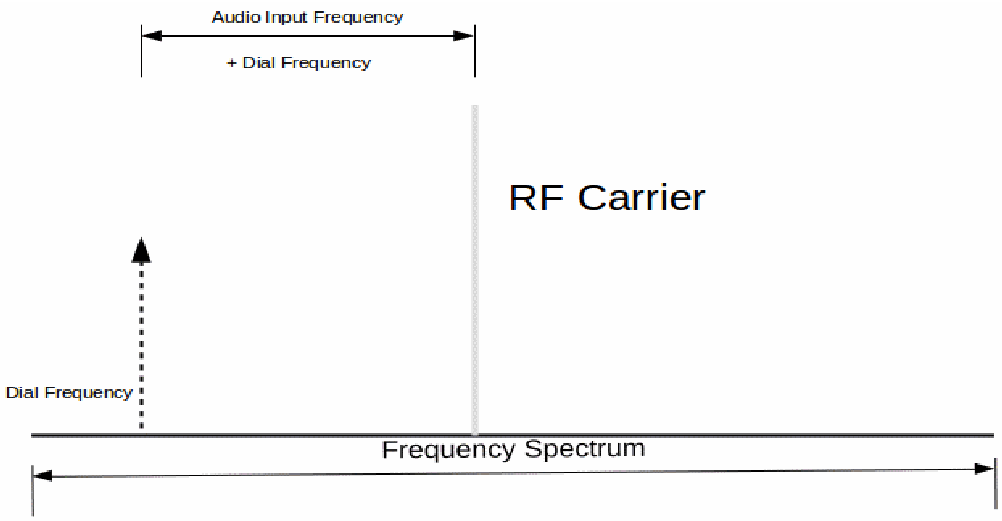
To answer this question accurately we need to first understand what these terms mean.

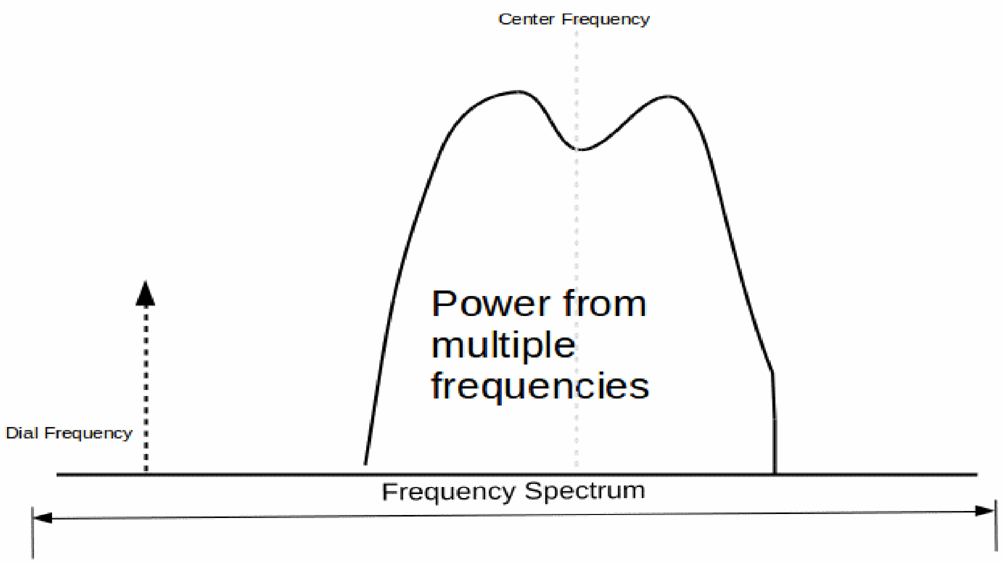
Dial Frequency

The dial frequency is obviously, the frequency shown on the rig dial – the frequency that would be transmitted if sending a genuine CW signal, FM or AM carrier. It is the center of the modulation for these transmission modes. Power is transmitted on each side of the dial frequency. This is much different from USB or LSB single sideband transmission. Perhaps it should be obvious to ham radio operators above Technical Class...but it is not always.

Center Frequency

The diagram (shown below) depicts single sideband transmissions and the hypothetical spectrum relationships between the frequency dialed in (the vertical dotted line) and the frequency (or frequencies) the power is actually output to (the curved line). This is an important distinction to make. We learned studying for the General Class license that when using different modes the actual frequency output by the rig may differ, depending on the mode, given a constant single audio frequency input to the mic. If your knowledge of this and other heterodyne methods is vague or lacking, consult the ARRL Handbook and refresh your knowledge on modulation methods.





We discussed previously that HF digital modes use Upper Sideband mode (USB). The very nature of the mode dictates that any audio frequency transmitted will cause a carrier at a frequency that is offset by the audio input frequency. If we send a 1000 Hz tone and our dial is 14.065 Mhz, the actual carrier will be at 14.066 Mhz – the dial frequency + the audio frequency. When we send a multitude of tones at many frequencies, like the MFSK or OLIVIA mode, we have power output carriers on each frequency above the rig dial frequency equaling the dial frequency + the audio tone frequency. We see this phenomenon when we receive the OLIVIA signal in FLDIGI. The waterfall shows activity in a range of waterfall positions – each indicates an offset from the dial frequency.

Having made the distinction, which do we use when specifying a net frequency or QSO meeting? For most digital modes the answer is *the dial frequency* with the addition of the offset for the center of digital tones. For instance, we specify the SATERN International Digital Net meets on 14.065 Mhz (the dial frequency) using OLIVIA 8/500 +1000 (the mode and offset center frequency) USB (the transmission mode). All that is necessary to fully describe how to receive the net signals.

Like everything in life there are exceptions. One exception is when you are using digital mode software that fixes the offset frequency by a pre-defined amount. A good example is The WinLINK client application RMS Express, when using the WinMOR mode. WinMOR uses a unique modulation technique that always centers all data on +1500 Hz from the dial frequency. Even the CW ID is an AFSK tone at 1500 Hz. The WinLink organization provides both the dial frequency and the center frequencies for all RMS Stations. Technically, it is redundant to specify the center frequencies since the center is always +1500 from the dial frequency for WinMOR. On the same theme, Pactor 1-4 also has a fixed center frequency offset for each of it's modes – usually around 1800-2200 Hz.

Another exception is AFSK digital modes (like MFSK and OLIVIA) on double sideband transmissions. For instance, if you are using OLIVIA on a VHF FM simplex or repeater frequency, all power is in the carrier that occupies the entire bandwidth. The AM mode (not normally used for digital) outputs power to both sidebands at once with a carrier at the dial frequency. So, in such an instance the right answer is to use the dial frequency because that where all the RF power is transmitted.

All this discussion is to illustrate two things.

1) There is not always a clear answer to our hypothetical question. It depends on one or more conditions.
2) We need to know the effect of our transmissions in order to avoid possible interference or transmitting out of band.

Here is a wrinkle to the definitions above. Often we find rig performance or band conditions do not allow for perfect offset placement. For instance, one particular rig in use may have a poor audio passband performance rolling off at 700 Hz and again at 2800 Hz with a pronounced peak around 1200-1500 Hz. This configuration would not easily accommodate the wider bandwidth of some digital modes. The MFSK128 mode requires at least 1K of bandwidth. If our rig centers on 1000, it means the lower tones from MFSK128 will be at 500 Hz – attenuated significantly by the sharp rolloff of our receiver. What do we do to receive the MFSK128 signal properly? Since we know the center frequency and the dial frequency we can interpolate these values to fit our situation. We wish to move the signals up slightly so they center on 1500 Hz instead of 1000 Hz. To do this we need to change our dial frequency -500 Hz lower. The lower dial frequency (14.0645 for our net frequency) pushes the center of the detected signals out to +1500. The transmitted frequency has not changed, just the receiver detected frequency. Now the lowest detected frequency will be 1000 Hz and the highest will be 2500 Hz. Well within our usable passband. This kind of workaround is necessary on older rigs with non-linear audio sections when used for digital communication.

Variations in operating for particular modes and changing conditions requres some art as well as scientific knowledge. Understanding these few simple principles of sideband transmission and reception will go a long way to make your digital experience a success.