Planning nets for SINCGARS

by Maj. John C. Keenan

Once the battle starts, the quicker that a call for support can be put through, the quicker that support will come. It's the job of C&E managers to preplan nets and ensure that appropriate outside stations are preset into the unit's radios so that those stations will be directly accessible.

SINCGARS promises to give the Army the best combat net radio (CNR) we've ever had. However, in order to take maximum advantage of its capabilities, we're going to have to change our way of thinking about how we build nets on future battlefields; we're going to have to engineer these nets with SINCGARS' unique capabilities in mind.

The key to successfully planning both internal and external net structures is knowing who needs to talk to whom. We need to precisely identify internal net structures as well as those nets outside our organization that we need to communicate with. Currently, most outside calling is done by looking up the desired station in the Communications-Electronics Operating Instructions (CEOI), changing one's radio to that frequency, then calling—using prescribed calling signs and procedures. While this procedure could still be followed with SINCGARS, it would nullify SINCGARS' electronic counter-counter measures (ECCM) frequency hopping capabilities when going outside normal operational nets, complicate the communications process for users, and eliminate the advantages of having six preset FH channels.

With frequency hopping, the only way to make normal outside users directly accessible is by identifying them early and preloading their ECCM variables into one of the presets. Such preplanning will enable these users to directly enter the nets in the frequency hopping mode. Remember: each SINCGARS receiver/transmitter (R/T) has six frequency hopping preset channels plus a cueing* frequency and a manual or electronic remote fill (ERF) frequency. Additionally, six other single channel frequency presets can be preloaded. Think about that for a minute. That's a lot of interoperability that can be programmed into the radio before you're under the gun. Once the battle starts, the quicker that a call for support can be put through, the quicker that support will come. It's the job of C&E managers to preplan nets and ensure that appropriate outside stations are preset into the unit's radios so that those stations will be directly accessible. Again, we've got to think ahead and plan—then train our users.

To illustrate the potential importance of presets, let's take the hypothetical case of an artillery forward observer who is supporting an infantry company and his parent battery. While in the middle of a fire mission, he notices a fast moving enemy patrol approaching an adjacent friendly unit's flank. Had he previously loaded the adjacent unit's ECCM variables into his R/T's presets, he could switch to that channel, pass the message (secure with ECCM protection), and continue his fire mission—all in a matter of seconds. However, if the adjacent unit's variables were not loaded into his presets, he would have to cue the adjacent net control station (NCS), wait for it to answer the cue (which could take a while because the NCS would have to leave its net or designate another station to answer), authenticate, and finally pass the message. Is he likely to do that? Probably not. He would probably just forward the message back through channels. Meanwhile, the value of the information would become less timely with every passing moment and might never get to the folks who needed to know it most. In combat, simplicity of use and timeliness of sensitive data cannot be overemphasized.

The current family of radios operates much the same as SINCGARS would in the example above without using presets. However, for SINCGARS to do all it was designed to do, Signal officers and NCOs must learn to plan and program their units' radios.

We also need to remember that SINCGARS nets will be built from the

**Cueing is a technique that allows SINCGARS radio to make contact with any other FM net as long as the user has a CEOI. It is a single channel call much the same as that used with the VRC-12 family. It allows the user to contact any FM net—SINCGARS or older FM radios.*

bottom up. Once battalions have established their most frequently called external point of contact, this information will be forwarded along with normal internal net structures up to the brigade level. Brigades, in turn, will merge all lower echelon data with that of their own organic and adjacent units and forward the list up to the assistant division communications-electronics officer (ADCEO) for inclusion in the division's locally produced automated CEOI. In addition to publishing regular battalion extracts, special extracts can be tailored for task forces and other special purpose units. Divisions will use this data along with the hopset and TRANSEC variables provided by corps to generate the CEOI and spectrum management data used by all subordinate units.

This will be done using the Battlefield Electronic CEOI System (BECS)—discussed in the Winter 1986 issue of ARMY COMMUNICATOR. Divisions will determine their total organic and adjacent requirements and their entry points into the corps' CNR network and forward these CEOI requirements to the corps Signal brigade, which will produce the master corps CEOI. In other words, each echelon will examine its adjacent, higher, and lower CNR communications requirements and feed them up to corps, which will receive the information and produce the new CEOI and spectrum management feeder data. This information will subsequently be distributed either manually or electronically back down to supported units.

There are many other reasons why net preplanning will become critical. Software limitations of the SINCGARS radio restrict the number of unique net identifiers to 1000. However, this is not a significant limitation because there are three other variables that can be altered to make an infinite number of unique nets: the TRANSEC variable, which is the pseudo-random hopping pattern; the hopset or frequency allocation; and the mission date/time of day (MD/TOD). Changing any of the four ECCM variables—net ID, hopset, TRANSEC, or MD/TOD—will create a unique hopping pattern. This is a good feature, but, as you might imagine, without an effective spectrum management plan, it also raises the potential for communications chaos. Though one could always fall back to single channel, the single channel alternatives are less than ideal. The better solution would be to find the right mix of frequencies and ECCM variables so that each net in the corps would have enough unique entities to operate without interference from outside nets, while at the same time maximizing its potential for direct communications with desired outside nets.

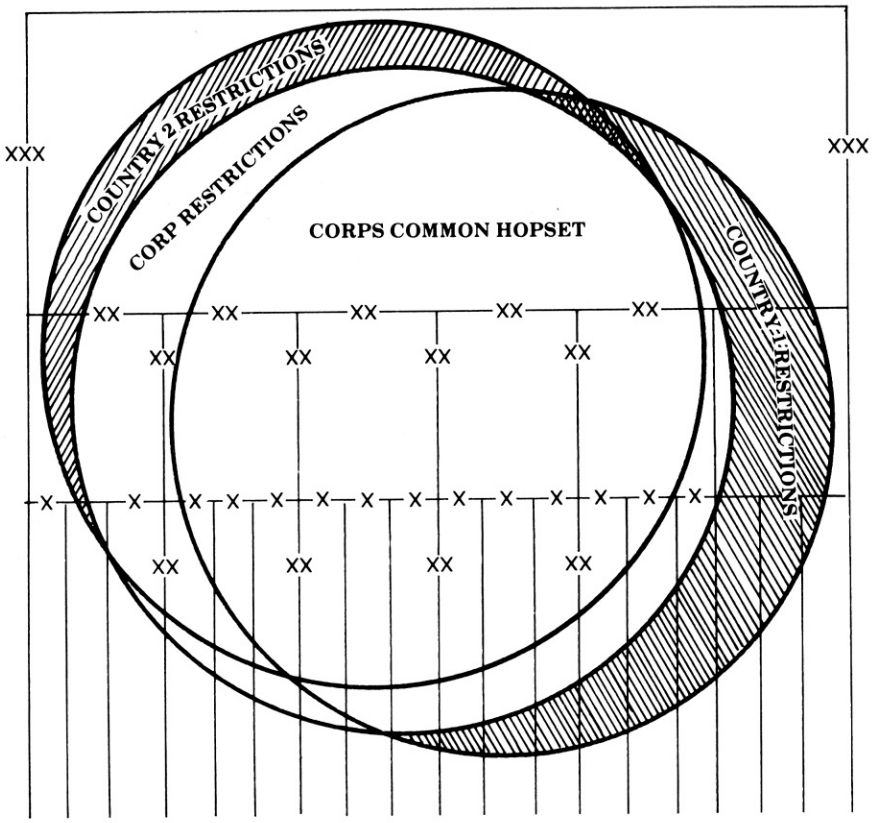
To maximize interoperability, one or more of the four variables need to stay common to all nets in the corps. The most likely candidate is the TRANSEC variable, since the radio can only hold two—one for the current time period and one for the subsequent time period. (NOTE: You can't go back to the old TRANSEC variable without an external reload once you've switched to the new one.) Another likely candidate is time, since it is established by the net controller. Time is also the easiest variable to alter locally because it does not require an external load.

That leaves net IDs and hopsets as the variables that are usually manipulated to give each net in the corps area its unique characteristics. Here's the way these variables can be managed with effective net planning and the use of BECS software. The corps frequency manager will chart the VHF frequencies available for SINCGARS and allocate them across the entire corps area as hopsets. More than likely, each divisional area will have a slightly different set of frequency allocations due to geographic or local restrictions. If not, a small number of frequencies (about 20) must be varied when building each division's hopset. This latter function, which will be programmed to occur automatically, will force each division to have a unique hopset and maximize the available frequencies. Since we also have to provide for cross communication between corps and divisional boundaries, we also must identify the set of frequencies common to all corps units. Once this identification is made, a system will be devised so that all units required to intercommunicate across corps and divisional boundaries can use the common corps hopset and a common set of net IDs. This will be the set of net IDs from 000 to 299 used in conjunction with the common corps hopset. All other net IDs, 300-999, will be available for each division and the corps proper to use independently. This will give us a system that will maximize the common hopset while preserving the integrity of corps and divisional hopsets. It is a system that will facilitate interoperability and provide full ECCM protection. Note, however, that in order to achieve immediate interoperability, each common and unique net must be loaded into the FH preset channels by stations which need to intercommunicate. Only then will the ECCM variables be synchronized ahead of time.

The figure on page 23 is a hypothetical representation of frequency sets that might be available to a corps. While a very rough representation, it may help us visualize how the frequency manager might effectively allocate hopsets to divisions. As it shows, even though foreign governments restrict specific frequencies in their country, those frequencies may be available in other countries. The same thing is true of frequencies restricted from use by the corps. After all restrictions are imposed, the remaining group of frequencies is the set available for use throughout the corps: the common hopset. This common hopset would be used for nets that must operate across the entire corps. The frequencies used in conjunction with the common net IDs would make up the corps CNR overlay. This framework would give the corps and subordinate divisions the capability to communicate.

The common hopset, together with those frequencies not otherwise restricted from use in a division, will constitute the division hopset. Divisions will use this larger hopset for internal use, along with the remaining 700 (300-999) net IDs, to generate their own spectrum management data. This process is not as complicated as it may seem. It is merely allocating unique net IDs to the various divisional nets, normally on a one-time basis.

This leaves two other variables to be managed—TRANSEC and mission date/time of day (MD/TOD). The TRANSEC variable, generated by corps, is the pseudo random hopping pattern on which all nets in the corps will hop from frequency to frequency. It will be consistent throughout the corps and passed down as part of the corps overlay disk. The MD/TOD is Zulu time provided by the local controller to his net.



Corps overlay with VHF spectrum superimposed

There has been a lot of confusion about the time synchronization of the SINCGARS radio. Actually, there will be three "times" associated with the radio. The first of these, delta time, is the variance between one net's time and another's. There can be a maximum of 59 minutes difference between any two nets. The second "time," late entry time, is how far out of time a user can be who desires to enter a net after it has been initiated. There is a maximum of plus or minus 59 seconds between a particular radio's time and the net time. The third "time," direct access time, is how far out of time a radio can drift and still be able to directly access other stations in a hopping net. This is plus or minus 4 seconds. Remember: once you're in a net, your clock will get precisely synchronized each time the NCS transmits. The way your radio can drift is if you have a different channel in which you do not normally operate preloaded as channel X. In this case, your clock will be pulled to your NCS and may drift from net X's time after many days of not entering its net. Once you switch to net X, if you are within the 8 second window, you can immediately begin transmitting. If not, as soon as the NCS of net X transmits, you again will be precisely synchronized. The internal clock is accurate to 5 parts per million, so it is unlikely that the clock will drift even when you're not regularly operating in a different net.

In this article, I have tried to provide a number of new concepts that the communications community will need to understand when SINCGARS hits the field. We all want it to be the best radio ever, and we're working to see that it is. The TRADOC System Manager's Office for Combat Net Radios will continue to keep you abreast of new concepts as well as of the SINCGARS' fielding status. If you have specific questions you would like answered, our AUTOVON number and address are:

AUTOVON 780-2057/2557
Commander, U. S. Army Signal Center and Fort Gordon
ATTN: ATZH-CR
Fort Gordon, GA 30905

The Signal Center is rewriting FC 24-2-1, *SINCGARS-V Frequency Management,* and FC 24-2, *Radio Frequency Management.* They will soon be available. If you need advance copies write:

Commander
U. S. Army Signal Center and Fort Gordon
ATTN: ATZH-DTL
Fort Gordon, GA 30905-5070

Currently stationed at Fort. Gordon, Ga., Maj. Keenan is the TRADOC system manager for combat net radio. He previously served as chief of fixed operations, 1st Signal Brigade; battalion executive officer, Headquarters, Fort Huachuca; and commander, Company A, 122nd Signal Brigade. Maj. Keenan has a B.S. from California State Polytechnical University and an M.S. from the U.S. Naval Postgraduate School.