How C-Bridge Talk Group Priorities Are Established
or
Why Do Other Talk Groups Interrupt My QSO?

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The DMR network in Maine is part of a worldwide system of repeaters. It is a more complicated system than the analog systems we have been accustomed to using. This complexity presents us with the challenge of how to best design and integrate our Maine-based DMR network with our neighbors and with the world. One of our objectives is to design our system so that our users are able to communicate without troublesome interruption, and this design must strike a balance between this objective and the overall flexibility of the system. In order to comprehend the tension between these competing objectives, it is helpful to understand how talk group priorities are established.

The goal of this document is to explain what talk groups are and how talk group priorities are established at the level of the C-Bridge. In order to understand talk group priorities and how the C-Bridge actually establishes talk group priorities, it is essential that one understands how hold-off timers (HOTs) function.

A C-Bridge is a server which directs audio from a single repeater to other repeaters in the system based on a set of rules. These rules can be changed at will to accommodate the needs of the users of the system. It is very flexible, but with flexibility come some compromises.

A talk group (TG) is established when a group of radios have been programmed to communicate with each other. Each talk group is assigned a unique number. The Maine statewide TG is assigned the number 3123. In a single repeater system, **Radio A** could communicate with **Radio B** through **Repeater 1** as long as **TG 3123** was programmed into a channel on each radio. The repeater is "dumb" in this scenario, it merely passes the audio from its receiver to its transmitter, and the real work is being done at the level of the radio. If the incoming audio is not preceded with the TG 3123 code, the receiver's speaker will not un-mute, and you won't hear the call. It's much the same as trying to listen to an analog repeater with the incorrect "PL squelch" code programmed into your radio. The signal is present, but you won't hear it.

In a system with multiple repeaters, the C-Bridge determines if and when audio from **Radio A** on **TG 3123** (or any talk group for that matter) talking though **Repeater 1** is passed to another repeater, **Repeater 2**, so that **Radio B** which is listening on **Repeater 2**, can hear the audio on **TG 3123.** The situation becomes more complex when radios are programmed with multiple talk groups. Since you cannot have two audio streams from two different talk groups flowing simultaneously on any time slot (TS) to any individual repeater, the C-Bridge will prioritize one talk group over another by using hold-off timers (HOTs).

The philosophy of the prioritization is that higher priority will be given to the talk groups which utilize the least number of repeaters. For TS2, the Local talk group (TG9) has the highest priority since it utilizes only one repeater. Maine SW (TG 3123), New Hampshire SW (TG 3133),

Region NNE (TG 8), and New England Wide (TG 3181), follow in decreasing priority because each utilizes an increasing number of repeaters.

Let's look an example of how hold-off timers create talk group priorities. In this example, it is assumed that each radio has its receive group set up to listen to all TS2 talk groups, that each repeater has been set up at the C-Bridge level so that it can potentially pass audio to and from all TS2 talk groups, that hold-off timers start counting down as soon as you start your transmission, and that each hold-off timer is set for 5 minutes.

WA1YEW through the New Sharon repeater starts transmitting at 9:00:00 on ME/SW and ends transmitting at 9:02:00. Hold-off timers (HOTs) for the lower priority talk groups, NH/SW, Region NNE, and New England Wide will start counting down from 5 minutes as soon as WA1YEW starts transmitting and will have a value of 3 minutes and the end of the transmission. These HOTs on the C-Bridge will prevent the New Sharon repeater from receiving or forwarding any audio to/from NH/SW, Region NNE, and the New England Wide talk groups. Therefore, ME/SW would have priority over these other talk groups because the lower priority talk groups would not be able to interrupt the conversation on ME/SW.

N1EKK answers WA1YEW through the Augusta repeater on ME/SW at 9:02:00 and ends the transmission at 9:04:00. Hold off timers for the lower priority talk groups, NH/SW, Region NNE, and New England Wide will start counting down from 5 minutes as soon as N1EKK starts transmitting and will have a value of 3 minutes and the end of the transmission. Just as with New Sharon, these HOTs on the C-Bridge will prevent the Augusta repeater from receiving or forwarding any audio to/from NH/SW, Region NNE, and the New England Wide talk groups.

At 9:04:00 WA1YEW could start transmitting on ME/SW and continue the conversation. This would restart the HOTs at 5 minutes on the New Sharon repeater and the process would repeat itself. What if at 9:04:00, WA1YEW wanted to switch to NH/SW or Region NNE or New England Wide to start another conversation? WA1YEW would have to wait another minute, until 9:05, for the HOTs to count down to zero. Similarly, N1EKK would have to wait until 9:07 on the Augusta repeater until NH/SW or Region NNE or New England Wide would be available.

Time	New Sharon HOTs	Augusta HOTs	Topsham HOTs
9:00:00 **WA1YEW TX ON ME/SW on New Sharon**	00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W
9:02:00 **WA1YEW TX OFF ME/SW N1EKK TX ON ME/SW on Augusta**	00:03:00 NH/SW 00:03:00 Region 00:03:00 N-E-W	00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W
9:04:00 **N1EKK TX OFF ME/SW**	00:01:00 NH/SW 00:01:00 Region 00:01:00 N-E-W	00:03:00 NH/SW 00:03:00 Region 00:03:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W

9:05:00	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:02:00 NH/SW 00:02:00 Region 00:02:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W
9:07:00	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W

In the above example, the HOTs for Topsham were never activated because no one transmitted through that repeater.

Let's say there was a user of the Topsham repeater, KY1C, that was not interested in the conversation between WA1YEW and N1EKK on ME/SW and instead wanted to use the Local TG on Topsham to communicate with another operator, K1JJS, on the Topsham repeater. Is this possible? Sure it is, but we will have to alter the times on the table just a bit. WA1YEW and N1EKK are (very) polite operators, so they leave a 10 second pause between transmissions so other people can join the conversation or use another repeater in the system.

Time	New Sharon HOTs	Augusta HOTs	Topsham HOTs
9:00:00 **WA1YEW TX ON ME/SW on New Sharon**	00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:00:00 ME/SW 00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W
9:02:00 **WA1YEW TX OFF**	00:03:00 NH/SW 00:03:00 Region 00:03:00 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:00:00 ME/SW 00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W
9:02:05 **KY1C TX ON Local on Topsham**	00:02:55 NH/SW 00:02:55 Region 00:02:55 N-E-W	00:00:00 NH/SW 00:00:00 Region 00:00:00 N-E-W	00:05:00 ME/SW 00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W
9:02:10 **N1EKK TX ON ME/SW on Augusta**	00:02:50 NH/SW 00:02:50 Region 00:02:50 N-E-W	00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W	00:04:55 ME/SW 00:04:55 NH/SW 00:04:55 Region 00:04:55 N-E-W
9:03:05 **KY1C TX OFF Local on Topsham**	00:01:55 NH/SW 00:01:55 Region 00:01:55 N-E-W	00:04:05 NH/SW 00:04:05 Region 00:04:05 N-E-W	00:04:00 ME/SW 00:04:00 NH/SW 00:04:00 Region 00:04:00 N-E-W
9:03:15 **K1JJS TX ON Local on Topsham**	00:01:45 NH/SW 00:01:45Region 00:01:45 N-E-W	00:03:55 NH/SW 00:03:55 Region 00:03:55 N-E-W	00:05:00 ME/SW 00:05:00 NH/SW 00:05:00 Region 00:05:00 N-E-W

9:04:10 **N1EKK TX OFF ME/SW on Augusta**	00:00:50 NH/SW 00:00:50 Region 00:00:50 N-E-W	00:03:00 NH/SW 00:03:00 Region 00:03:00 N-E-W	00:04:05 ME/SW 00:04:05 NH/SW 00:04:05 Region 00:04:05 N-E-W

In the above example, at 9:02:05, KY1C is able to transmit on Topsham on the Local TG because N1EKK left a ten-second pause. Once KY1C transmitted on Local through the Topsham repeater, it activated HOTs for ME/SW, NH/SW, Region, and N-E-W for Topsham at the C-Bridge. The C-Bridge will not pass audio to or from the Topsham repeater for these TGs for 5 minutes, the 5 minute time period starting at the initiation of the last Local TG transmission on the Topsham repeater. Now the Topsham repeater is totally isolated from any conversations on TS2. Meanwhile, WA1YEW and N1EKK are enjoying an independent conversation on the Augusta repeater and any other repeaters in the system which have ME/SW as a TG can listen to the conversation. Any users on the Topsham repeater would have to wait to use or hear any other TG on TS2 until the 5 minute HOT timer expired which would be 5 minutes from the initiation of K1JJS's last transmission, at 9:08:15.

Hold off timers are a compromise. If you set them too short, other talk groups can interfere with your conversation. If you set them too long, you might be sitting around for a few minutes unable to use a talk group that you want to use.

Here is another situation to consider. You are sitting at your kitchen table enjoying your morning coffee with one hand on your coffee cup and the other grasping your brand new CS 751 HT. You make a transmission on ME/SW on the Augusta repeater. No one answers. You change to NH/SW and make a call. Your receiver is silent. Sensing people in NH and ME may not want to talk to you, you try Region NNE. Still, no luck. Exasperated, you try New England Wide. The silence is deafening. Are you unpopular? Maybe, but what is really happening?

When you keyed up ME/SW on Augusta, you activated hold-off timers for all of the lower priority talk groups which include the NH/SW, Region, and New England Wide talk groups. Assuming all of this took place within 5 minutes of your initial transmission, each time you transmitted on NH/SW, Region NNE and New England Wide, the only repeater transmitting your audio was Augusta. So, now you'll have to wait for the hold-off timers to expire to talk on these wider yet lower priority talk groups.

Finally, to answer the question, "Why do other talk groups interrupt my QSO?". People have observed that the NH/SW talk group has been infringing on the ME/SW talk group. What I think is happening is that the hold-off timers are expiring. Let's say that three people are using ME/SW for a QSO on three different repeaters. Hold-off timers are currently set for 5 minutes. Ham #1 talks for 2 minutes though repeater #1. Ham #2 talks for 2 minutes on repeater #2, and Ham #3 talks for 2 minutes on repeater #3. Six minutes have gone by, therefore the hold-off timer on repeater #1 has now expired for 1 minute. If, when Ham #3 stops transmitting, there is an active conversation on NH/SW or Region or New England Wide, it will be heard on repeater #1.

Should we increase the length of the hold-off timers to prevent this? Maybe, but, referring to the previous example, you may be sitting at your kitchen table with a cold cup of coffee by the time you'd be able to make a transmission on a wider talk group.

With the rapid growth of the number of DMR users and the DMR network in Maine, the time slot traffic loading will require ongoing evaluation. If changes are necessary, they will be made in a collaborative fashion with the repeater owners to support the local users and the quality of communications within the state of Maine.

For those interested in learning more about the C-Bridge and how the MOTOTRBO DMR system works, the following are good resources.

The MOTOTRBO System Planner can be downloaded off the internet. Just do a search on your favorite browser, you can't miss it. It is 520 pages and not a quick read.

Go to Rayfield Communications and download the C-Bridge manual. It is128 pages long.

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See you on the radio.