Basics of DMR Codeplug Programming

A Primer for Ham Radio Operators new to the DMR world.

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Introduction

Creating a codeplug is a 'bottom up' process where the lowest (common) elements must be created first, then built upon until you arrive at a fully functional codeplug that can be loaded into a radio. Each radio has unique software for both creating the codeplug and writing it into the radio for use. When you start with a new codeplug, many lists and groups are populated with the single default entries, which may be used as placeholders for initial creation of lists. Later on you will return to some of these and replace the defaults with actual configured entries. This will depend on the radio/software combination and its specific capabilities. Your actual sequences will need to be adjusted to suit your specific environment.

Step 1: Create your Contacts list

Program a Full Set of DMR-MARC Groups you may wish to monitor or talk on.
You may need a base set of up to 200 if you plan to travel outside your local area! Build the contact groups for ALL of the pre-assigned talk groups – use 'standard names'.
This list can be found at: http://dmr-marc.net/media/worldwide-talkgroups-v4.1.xlsx I do suggest that you populate your 'Contacts' list with a full set of USA and worldwide talk groups (about 150-200). If you are only going to be using local repeaters, you only need the talk groups you can access that are enabled on those repeaters. Hint: If your software allows you to export a contact list, do it now so that you can import the same list (if you are creating more than one codeplug). You may also wish to add some 'spare' unused placeholder contacts for future use. These can be in any place in your list and may save you the trouble of trying to insert a contact in a very large contact list. There is usually plenty of space for even a very long contact list. Warning: The 'Contact' list is position dependent, if you insert a contact in the list, all of the references to any contact in your list below this point will be broken! See below.

Step 2: Add your Private Contacts

Add your favorite (Private) contacts at the bottom of your Group Contacts list. Be careful to not insert Contacts into an already created Contact List! This will change every 'Channel' TX contact in use below the point you inserted a contact as channels use the position in the Contact List as its reference! Add your private contacts to the bottom of the contact list (sorted order - preferred). If you wish to look up a particular persons DMR ID, you can search for these IDs at: http://www.dmr-marc.net/cgi-bin/trbo-database/ . This page also has links to where you can obtain larger data dumps of the database of worldwide users and repeaters.

If you have many groups to use, look into exporting a previously created list from another codeplug and importing a sorted list as a starting point. If you have no channels created, you are free to add contacts in any order you wish, but I do suggest *using a 'common' group list that you export and import for all of your programming!*

Step 3: Create your first RX Groups

Create a RX Group for all the talk groups on slot 1 of the repeaters you will use.
Likewise create a RX Group for all the talk groups on slot 2 of the repeaters you will use. Create RX groups based on the 'network' naming which contain each talk group used by the network. You will need 2 RX groups for each network', one for slot 1 and 1 for slot 2. You should not have a talk group in both slot 1 and slot 2 (avoid this!). Some networks are subset of a larger set of talk groups and you may use these (larger groups) for those channels that use less than the full talk group set.

Step 4: Create a your first Scan List

Create a scan list with one 'channel' for each repeater on slot 1, and one slot 2 channel. Initially just create an 'empty' scan list to use during the channel creation step. Create a Scan list name that relates to your set of channels. Keep scan lists short! Hint - in your codeplug, all scan lists start with two channels: The first channel is the 'ON' or 'FULL TIME' talk group for slot 1, the second is the 'FULL TIME' or 'ON' talk group for slot 2. Adding more than a few channels to your scan list may overload the CPU of the radio and cause problems. This method reduces the CPU loading on the radio that might occur if all of the channels in the zone were placed into the scan list – that method is also redundant and wastes 'time' (in CPU cycles) inside the radio. Some firmware versions do not handle that gracefully!

An Alternate Method

An alternate method of creating a scan list (if you wish to have all of the channels in a particular 'zone' in the list) is to create two "dummy" channels called "slot 1" and "slot 2". these 'channels are not put into the 'Zone' but have all of the parameters set such as the frequency, offset, color code and a RX Group set to include all of the talk groups on this time slot. Name the receive group with whatever you wish, but include the "S1" or "S2" as appropriate and the name of the 'Zone" it is used in. For Instance, in the case of the Orlando Area KJ4OVA repeater, we would have two channels (KJ4OVA S1 and KJ4OVA S2) and two RX Groups (KJ4OVA S1 and KJ4OVA S2). Note: You can name these two elements the same (helps to keep them organized) because they are in different functional areas. Set the S1 or S2 RX Group in the S1 or S2 'channels (as appropriate).Set the "Scan List" field in each channel to this Scan List name. The S1 and S2 'channels are the only members of the 'Scan List' for this 'zone'. The radio will always receive the 'TX talk group' for the selected channel. Now you can choose one of two methods of functionality depending on your personal choices: 1) IF you want to hear all traffic on a selected channels' time slot, Set the appropriate S1 or S2 RX Group in all your channels in the 'zone'. 2) If you do NOT want to hear all traffic on the time slot, simply set the RX group to "None "for these channels. If you want to hear all traffic on the repeater, simply put the radio in 'Scan' mode. You can try out each method by simply setting each channel to have an RX Group or set to "None". This method allows you to have a short scan list that can be quickly scanned and if there is activity, you will see the talk group of that activity. There is no need to add all of the channels in the 'zone' to the scan list! If you choose to not use the RX groups be careful if a slot is active, you may inadvertently disconnect users already in a QSO! This will most likely earn you a stern warning from other users! Most radios will only handle 32 scan lists.

Step 5: Create a Zone

Create a 'Zone' name (that relates to the name of the scan list in step 3 and the RX group in step 2) and leave empty for the time being. Creating a 'Zone' allows you to put your configured 'channels' into logical groups. You can use the same 'name' for these (as your Scan List names) to help you keep things straight in your mind, they are in two different sections, so there in conflict. You will need to create a zone in order to select the group of channels you will be adding. Naming choice is up to you, but most 'Zones' have a limit of 16 channels. You can name each zone by the geographical location or any other name you wish. Add your channels in the order you wish them to be accessed by the top knob or menu selection. You may wish to use a name for your zones that relates to its 'Scan Lists'. Do NOT add the "S1" or "S2" channels into the 'zone' as these are for the scan list only.

Step 6: Create your Channels

Create 'channels' for each repeater and talk group. Using data from the DMR-MARC website or any other source, program the RX frequency, TX frequency (or offset), the proper color code, slot and TX talk group (from your previously created Contact List). Use one of the RX Groups previously configured or you will need to go back and forth which leads to errors in configuration. Apply the correct slot 1 or slot 2 RX group, and select the Scan List you will place the channel into.

My method has the time slot 1 'ON' channel first (Usually 'North America – TG=3), then all of the time slot 1 talk groups in sequence (low to high), then the slot 2 'ON' channel (usually Local Repeater-TG=2), then all of the time slot 2 talk groups in sequence (low to high).Continue adding repeaters and channels by repeating steps 3 through 8. Save your file after each Zone is added, this might save you in case the power goes out!

Step 7: Populate Your Scan List

Go back to your Scan List, add the 'ON' channels for slot 1 and 2 to this list from the just created group of channels. Or you may also implement the alternative method, understanding the limitations.

Step 8: Populate Your Zone with Channels

Go back to the Zone List you previously created for this Zone and add in the first 16 channels (for most radios) of the most recent group you added. Most radios can only have 16 channels in a zone, so pick the ones you want. If you need more, then you create another Zone and add the ones missing. If the talk group is in the less used second zone, you will need to change zones and channel to reply (unless you set a sufficient delay in scanning). With this method, your scan list will scan all active talk groups on any channel, then you rotate the channel selector to that talk group to respond.

Step 9: Repeat Steps 1 through 8

Repeat steps 1-4 for each new Zone.
Write (Save) your file out at regular intervals to ensure your work is not lost by a power failure or computer hiccup!

Step 10: Create Analog Zone and Channels

Add a zone for your analog channels, then add each repeater as a channel (up to 16 per zone). Name your zone by its function or geography (choice is yours). Optionally you can also create scan lists for your analog channels and assign a scan list to a group of channels or an entire zone. Whatever you wish.

Step 11: Write the Codeplug to your Radio!

Write the file to your radio. Save the file to your PC with a name that you will remember.
Some CPS software will allow you to keep 'notes' on each file. You may wish to use version numbers in your file naming to help you with progressive updates. At some point you may 'break' your codeplug by setting something differently and this may affect the radio operation. It helps to be able to 'go back' to an earlier working version. Some CPS software may also require that you update the clock in the radio by another function, be sure to do this if you want an accurate time display!

Fine Tuning Your Codeplug

Optimizing Scan Operation

Depending on the specific transceiver firmware and capabilities, you may be able to customize the scan functions to your liking. This will involve changing the timing and other parameters to suit the way you want your radio to operate.

If you wish your radio to give you additional time to respond to a call during scan operation, you should extend the 'hang time' parameter for the scan list. There are a few parameters in the scan list that can be optimized (to a certain degree). If you have a large number of receive talk groups on some channels in your scan list, then you will want to extend the 'Priority Sweep Time' parameter (or whatever the name of this function is in your software/codeplug programmer is) from the usually default timing (probably about 2 seconds or 2000 msec.) to something a bit longer (I suggest 5 seconds). This will allow the radio to complete its scan list on a less frequent interval allowing for time to 'scan' the entire 'receive group list' of talk groups before restarting a new scan. If you radio does not finish processing the scan list before its allocated time (priority sweep time) then you may not hear activity on some talk groups. Organize your receive scan list priority to place the most important talk groups at the top of the list – higher priority, so adjust according to your preferences. Adjust the 'hang time' to allow you enough time to pick up the radio and view the screen (set your backlight timeout value to this time also) to see if wish to respond. My personal preference is to 'hang' for about 10 seconds then resume scan if I don't wish to respond.

Scan Stop (Hang Time) Response Options

There are three options as to what happens if you wish to respond within the 'hang' time period. If you wish to respond on the same talk group, then set the parameter 'Scan TX Mode' or whatever your software calls it, to 'Last Active Channel'. This will retain the last talk group (where scan stopped) as the talk group to respond on when you PTT.

For the Hytera and similar radios the three options are described as:

1. Selected: The radio transmits on the channel in which it enters Scan mode.
    (always respond on the channel that the selector knob is set to)

2. Last Active Channel: The radio transmits on the channel where it was previously (this would be the channel that it stopped on during scan mode)
3. Designated TX Channel: The radio transmits on a channel set in Designated TX Channel field. (this is generally NOT the way we operate in Ham Radio usage)

If you wish to respond on the 'last active channel' (during the 'hang time period), select the second option: 'Last Active Channel'. Remember that this will change the 'active' or 'selected' talk group. If you're your radio has the 'Talkback' option and it is enabled, this is the default operation, but choosing 'Last Active Channel' will keep this setting active (overriding the normal channel selector setting). Also don't forget that scan will resume automatically after the 'hang time' has expired, but will leave your TX contact (talk group or 'channel') set to the 'Last Active Channel'. You can then turn scan OFF and resume 'normal' conversation. Remember to check what the 'selected' channel is, (by turning the channel select knob) and verify you want to use that 'channel'.

Priority Channels

You may choose to enable 'Priority Channel' scanning if you wish assign a more frequent scan of particular channels. If only Priority Channel 1 is set, 50% of a radio's scans are on Priority Channel 1 during scanning. If Priority Channel 2 is set to *'None,'* scans for Priority Channel 1 are reduced from 50% to 25%. This may require you to choose how you allocate or enable Priority Channel Scanning. If no Priority Channel is set, the scan list is repeatedly scanned with no priority (round-robin fashion). Normally you should not need to enable these options.

Sample Contact List

The table below lists a 'sample' basic contact list (without local 'private contacts') that you may wish to employ for your first codeplug exercise. This list should be enough for most USA code plugs and has the SPARE contacts or UNUSED contacts that can be edited to maintain a sorted and readable list. CAPITALS indicate frequently used talk groups.

Remember to always ADD to the bottom of the list when adding your 'private' contacts.

No	CallAlias	CallType	CallID
1	ALL CALL	All Call	16777215
2	XPT Call1	XPT Group Call	1
3	WORLDWIDE 1	Group Call	1
4	LOCAL NETWORK 2	Group Call	2
5	NORTH AMERICA 3	Group Call	3
6	Asia 4	Group Call	4
7	Oceania 5	Group Call	5
8	Africa 6	Group Call	6
9	South America 7	Group Call	7
10	Regional Group 8	Group Call	8
11	LOCAL REPEATER 9	Group Call	9
12	WW German 10	Group Call	10
13	WW French 11	Group Call	11

14	WW- Open 12	Group Call	12
15	WW ENGLISH 13	Group Call	13
16	WW SPANISH 14	Group Call	14
17	WW Portugese 15	Group Call	15
18	WW Italian 16	Group Call	16
19	WW Nordic 17	Group Call	17
20	WW Russian 18	Group Call	18
21	WW Open 19	Group Call	19
22	UNUSED 20	Group Call	20
23	UNUSED 21	Group Call	21
24	UNUSED 22	Group Call	22
25	EU English 23	Group Call	23
26	EU Spanish 24	Group Call	24
27	UNUSED 25	Group Call	25
28	UNUSED 30	Group Call	30
29	UNUSED 33	Group Call	33
30	UNUSED 34	Group Call	34
31	SIMPLEX 99	Group Call	99
32	Tech Talk IL	Group Call	100
33	UA 113	Group Call	113
34	UA 123	Group Call	123
35	CANADA	Group Call	302
36	TAC 310	Group Call	310
37	TAC 311	Group Call	311
38	TAC 400	Group Call	400
39	TAC 410	Group Call	410
40	NY BRONX TRBO	Group Call	444
41	MITS US 1776	Group Call	1776
42	2020	Group Call	2020
43	Newfoundland	Group Call	3020
44	Nova Scotia	Group Call	3021
45	Quebec	Group Call	3022
46	Ontario	Group Call	3023
47	Manitoba	Group Call	3024
48	Saskatchewan	Group Call	3025
49	Alberta	Group Call	3026
50	British Columbia	Group Call	3027
51	Northern Terr.	Group Call	3028
52	New Brunswick	Group Call	3029
53	DCI BRIDGE 3100	Group Call	3100
54	Alabama	Group Call	3101
55	Alaska	Group Call	3102
56	Arizona	Group Call	3104
57	Arkansas	Group Call	3105
58	California	Group Call	3106
59	Colorado	Group Call	3108
60	Connecticut	Group Call	3109
61	Delaware	Group Call	3110

62	District of Col.	Group Call	3111
63	Florida	Group Call	3112
64	Georgia	Group Call	3113
65	Hawaii	Group Call	3115
66	Idaho	Group Call	3116
67	Illinois	Group Call	3117
68	Indiana	Group Call	3118
69	Iowa	Group Call	3119
70	Kansas	Group Call	3120
71	Kentucky	Group Call	3121
72	Louisiana	Group Call	3122
73	Maine	Group Call	3123
74	Maryland	Group Call	3124
75	Massachusetts	Group Call	3125
76	Michigan	Group Call	3126
77	Minnesota	Group Call	3127
78	Mississippi	Group Call	3128
79	Missouri	Group Call	3129
80	Montana	Group Call	3130
81	Nebraska	Group Call	3131
82	Nevada	Group Call	3132
83	New Hampshire	Group Call	3133
84	New Jersey	Group Call	3134
85	New Mexico	Group Call	3135
86	NY TRI-STATE	Group Call	3136
87	North Carolina	Group Call	3137
88	North Dakota	Group Call	3138
89	Ohio	Group Call	3139
90	Oklahoma	Group Call	3140
91	Oregon	Group Call	3141
92	Pennsylvania	Group Call	3142
93	Rhode Island	Group Call	3144
94	South Carolina	Group Call	3145
95	South Dakota	Group Call	3146
96	Tennessee	Group Call	3147
97	Texas	Group Call	3148
98	Utah	Group Call	3149
99	Vermont	Group Call	3150
100	Virginia	Group Call	3151
101	Washington	Group Call	3153
102	West Virginia	Group Call	3154
103	Wisconsin	Group Call	3155
104	Wyoming	Group Call	3156
105	DCI 1	Group Call	3160
106	DCI WW	Group Call	3161
107	DCI 2	Group Call	3162
108	DCI NA	Group Call	3163
109	DCI I-5 CA	Group Call	3168

110	Midwest	Group Call	3169
111	Northeast	Group Call	3172
112	MidAtlantic	Group Call	3173
113	Southeast QSO	Group Call	3174
114	Texas OK CALL	Group Call	3175
115	Southwest	Group Call	3176
116	Mountain	Group Call	3177
117	NEng-NBrunswick	Group Call	3181
118	Cactus	Group Call	3185
119	Hytera USA Link	Group Call	4639
120	TAC 1	Group Call	8951
121	Parrott	Group Call	9998
122	NorCal Audio	Group Call	9999
123	NC/PRN Local	Group Call	27500
124	FIRST COAST N FL	Group Call	31121
125	UNUSED 31122	Group Call	31122
126	UNUSED 31123	Group Call	31123
127	UNUSED 31124	Group Call	31124
128	UNUSED 31125	Group Call	31125
129	UNUSED 31126	Group Call	31126
130	DCI Comm 1	Group Call	3777215
131	DCI Comm 2	Group Call	3777216

A Case of 'SIMPLEX' Disease

If you wish to use simplex (transmit and receive on the same frequency in DMR digital) there are multiple ways to accomplish this.

The DMR Standard

The DMR-MARC talk group list specifically calls out talk group number 99 as the 'Simplex' talk group number. Programming a channel for this involves selecting the "Simplex" talk group into the TX contact name. The 'Simplex' Contact should be designated a 'Group Call' and not a 'Private' call, this way multiple users on your simplex frequency will all be able to talk to each other. When programming your simplex channel ensure that you program a "0" offset so that both the receive and transmit frequencies are the same. In most radios you do not need to specify a receive group as the transmit group is automatically included. Ensure that you do not de-sense the radio by transmitting in close proximity to each other.

The Alternate Method

An alternate method of accomplishing the same results would be to program a simplex frequency to use and set both transmit and receive frequencies the same (as above), but instead of using the 'Simplex' talk group for your transmit contact, you would use the universal 'All Call' group transmit contact so that anyone on this frequency would hear you (if within range) no matter what receive group the other party has programmed into their 'simplex' channel. This method has the advantage that you will be heard even if the other party has an incorrect transmit contact entered.

Using Talk Around

Talk-Around is the process of using a repeater's output frequency for local communications without tying up the repeater. This is obviously a limited range utility. Each radio/CPS combination will have a slightly different method of implementing this function, but the basics are the same. Simply check the 'Talk Around' check box in the channel programming area and this will allow you to turn 'ON' the talk around function from the radios menu system or button programming. In some radios this might be called 'direct mode' while in others it will be labelled 'talk around'. Using this method, all users must select one of the repeater's talk groups as the transmit contact and then all users enable the 'talk around' function on that talk group (or repeater 'channel').

It is best that all 'simplex' users agree on the methodology that will be used in your local group as each method has its advantages and restrictions. All should agree how this will be used.