

DMR Codeplug Design

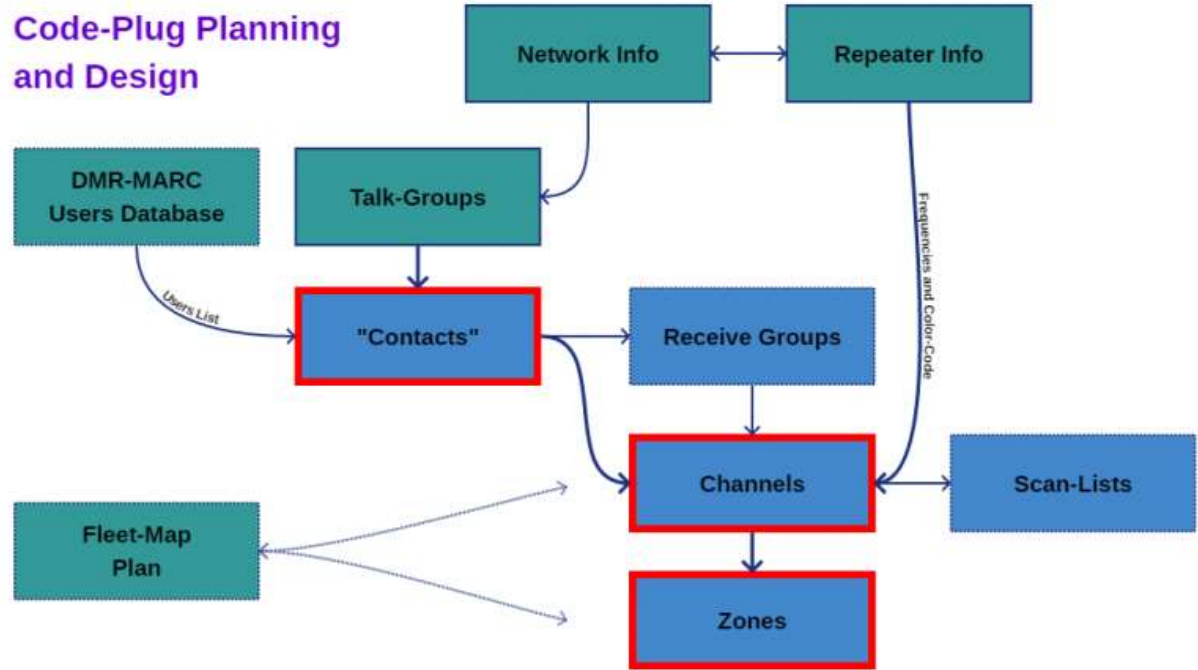
If I give you a code plug you can talk for that day.

If I teach you how to make a code plug you will be able to talk forever...

Research

What data to collect

Code-Plug Planning and Design



Fleet-Maps

Create a table of what you want your radio layout to look like...

What area do you want to cover?

What Talk-Groups interest you?

How much space does your radio have?



What data do you need to collect?

You need(want) a name/location/call for the repeater. What do you want to call it?

You need(!) frequency details. What will you listen on and what frequency will you transmit on?

You need(!) the “color-code”. This is like a PL tone and without knowing this, you will be ignored by the repeater. Some frequency coordinating bodies require or recommend a Color-Code based on location. Originally, Color-Code 1 was the norm in the amateur community.

You need to know what talk-groups are supported and the numbering convention. It's helpful to know what network the repeater is connected to.

Choosing a name for your repeater

“Highland” - Almost every state has a Highland. Some states may have more than one. Should I call it Minnesota.Highland? Maybe MNHLND? MN.HIGLND?

Should we call it NØNKI or NONKI or NKI or What if NØNKI has more than one repeater?

What’s the local convention? Do we know, maybe this codeplug is for an upcoming trip out of our local community.

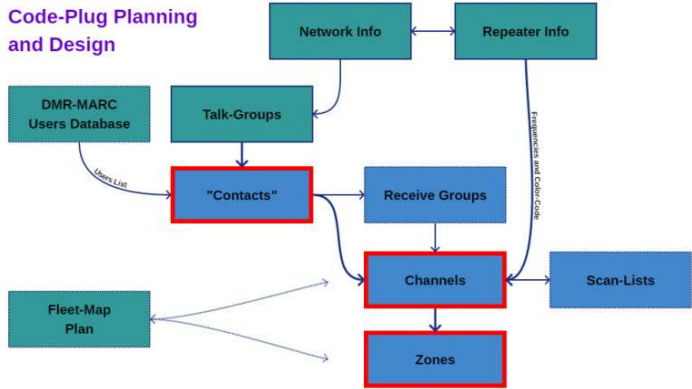
Is “Highland” as a name taking up too much space on my screen?

“MSP”, Isn’t that an airport? Wasn’t MSP at the U downtown? What about the second system that got installed downtown? What about the really wide coverage system?

Frequencies and Color Codes

Just what is a Color-Code

+5Mhz or -5Mhz, which is my transmit, which does the repeater transmit?



Networks, Oh so many Networks

“The Internet” - a network of networks. Yes, the network and the Network are the same but different. Not all parts of the network are the same. Some networks have private spaces, like maybe at your office?

DMR is similar. There are “Private” areas on some networks and there are interconnected parts too.



Networks - The same but different?

“Minnesota State” TG-3127 is pretty universal. I think most of the US networks that cover this area have this patched together as one on a full time basis.

TAC310 is similar, all the networks patch on a full time basis

- But let's not confuse full time patches with full time talk-groups. More on that later.

TAC314 would be an example where it may exist on multiple networks, but might not interconnect 314 with other networks 314.

Where to find the facts

DMR-MARC

Brandmeister.Network

State or Local Repeater Council

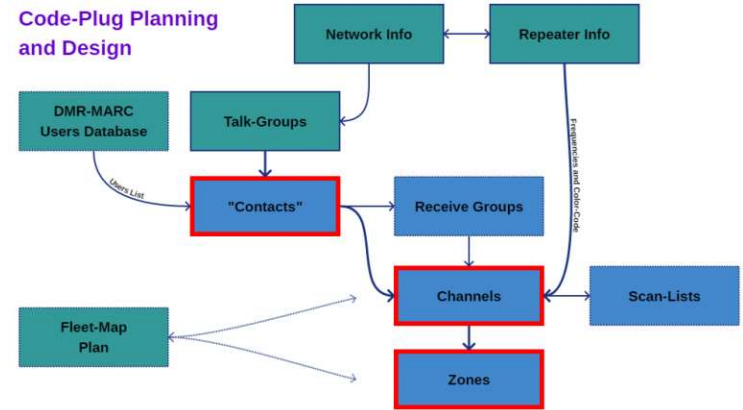
DMR Websites like: <https://MinnesotaDMR.com/>

Word of mouth

Google Search: <http://www.azrepeaters.net/index.php?n=RepeaterMaps.Mototrbo>

<https://www.repeaterbook.com/repeaters/niche/index.php?mode=DMR>

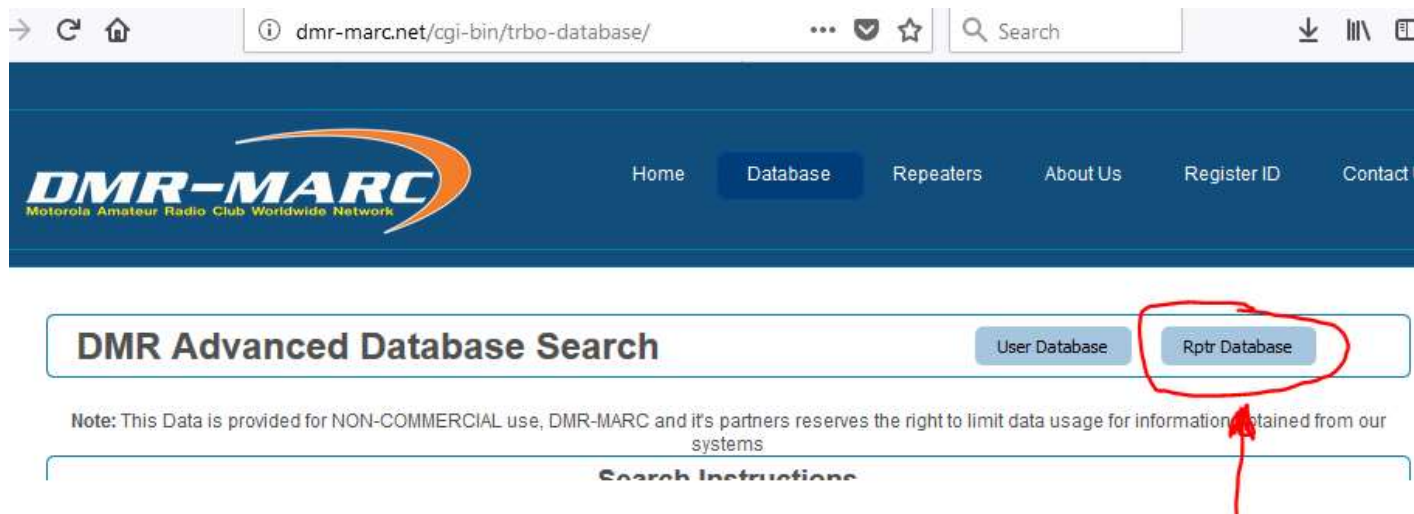
Code-Plug Planning
and Design



DMR-MARC

Extracting details

First find the site, click database and find the repeater database:



Brandmeister.Network

<https://brandmeister.network/>



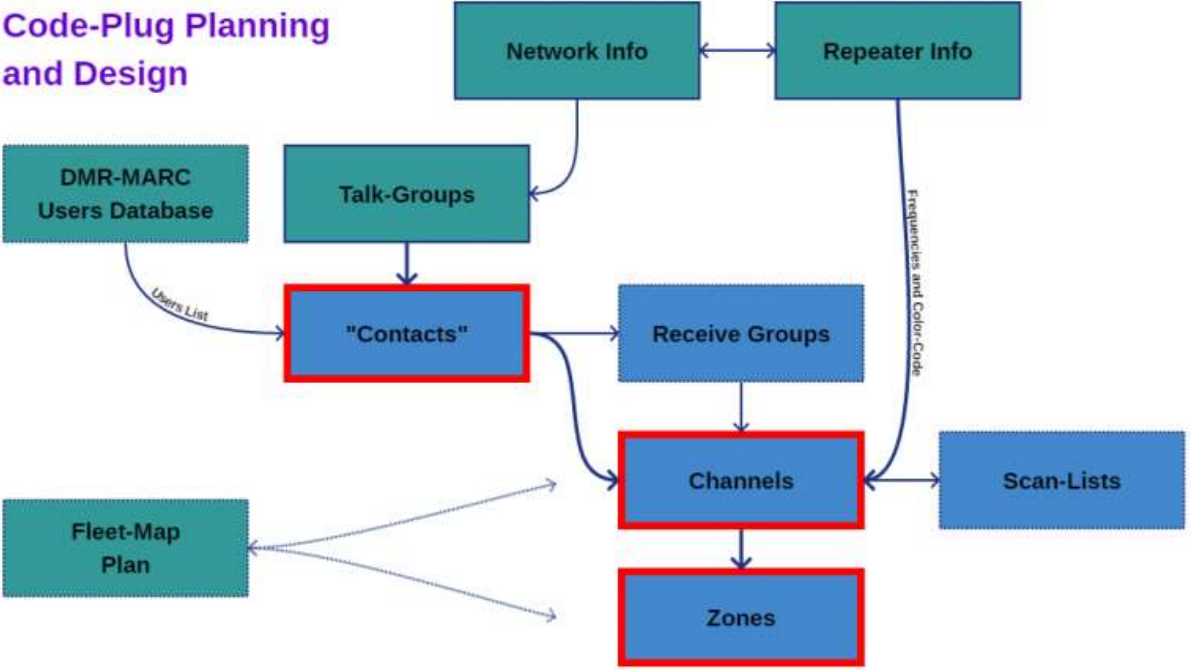
Quick Vocabulary

Network

Talk-Group

Repeater

Code-Plug Planning and Design



RX-Groups

A list of talk-groups the radio should decode and listen to.

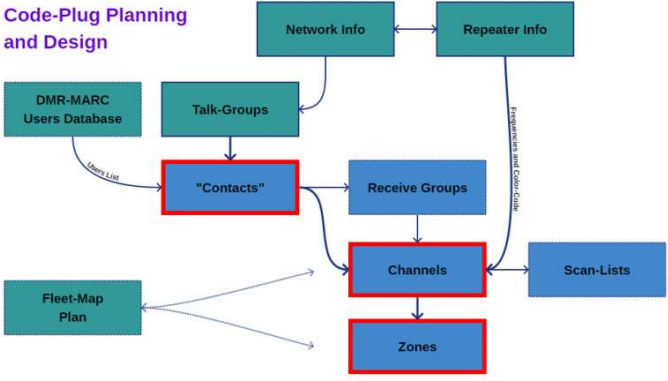
Most radios will for a period of time respond with the contact ID or talk-group ID that was recently decoded...

So imagine you are talking with someone on Minnesota State but TAC310 is in your RX-Group... Your radio might transmit on TAC310 instead of Minnesota State... Confusing for sure unless you know what this is about and want this! You most likely don't want this... If you did, you would know you did.

Scan-Lists

For every channel on your radio, you can create or “link” a list of channels to monitor or “Scan” when the scan feature is enabled.

So let’s say you tune your radio to “MKA.MNState”, If you press the scan button, what “channels” do you want to be able to monitor? Maybe MNState on nearby repeaters? Maybe MNDMR?



Zones

It's really just a way to group your "channels" into folders or buckets or lists...

Most commercial radios (and DMR is a commercial radio concept), only have a limited number of "channels". Most radio users do not have a need to be on more than a few "channels"... Are you a Security Guard? Why would you have more than a couple "slots" on your channel selector?

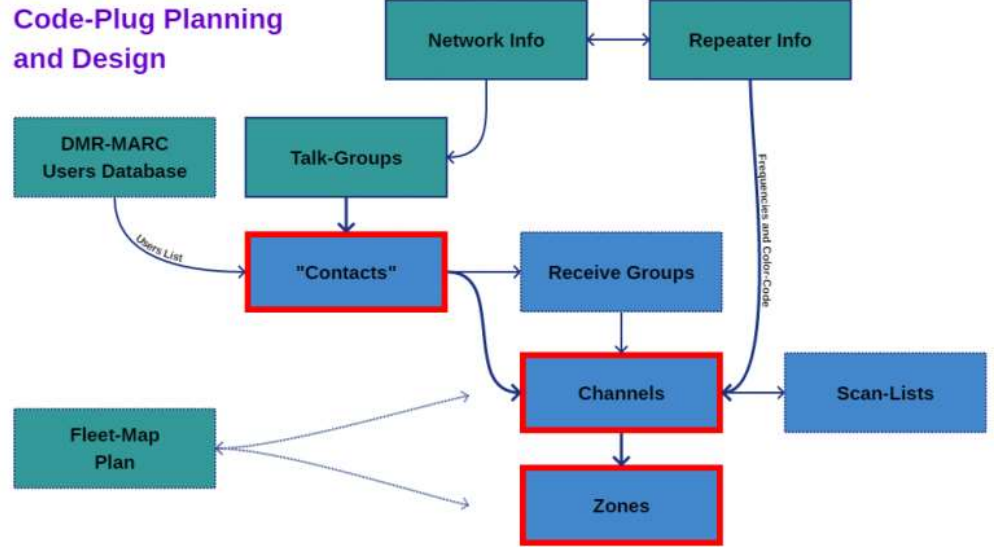
Do you want to group your "channels" by talk-group or repeater or area? When will you want to change "channels"? Maybe while driving? In a hurry?



Contacts

Talk-Groups and User Aliases:

- Group Call
- Private Call



Contact ID's

Everything (users/Talk-groups) you can send a message to needs a “Contact ID”.

Most of the time, you are sending messages to a “Talk-Group”... Remember you have private contacts and you have group contacts... These are all 24-bit addresses... bit = binary numbering. $1 + 1 = 10$, $10+01=11$ $1111 = 15$ in decimal.

Decimal has the following characters to represent values: 0,1,2,3,4,5,6,7,8,9

Binary has only these two characters: 0,1

1111 1111 1111 1111 1111 11111 (maximum sized value)

Numbering Scheme in DMR

It's actually based on Cellular telephones dating back decades now.

The MCC - Mobile Country Codes

https://en.wikipedia.org/wiki/Mobile_country_code

- 0 - [Test networks](#)
- 2 - [Europe](#)
- 3 - [North America and the Caribbean](#)
- 4 - [Asia](#) and the [Middle East](#)
- 5 - [Oceania](#)
- 6 - [Africa](#)
- 7 - [South and Central America](#)
- 9 - Worldwide ([Satellite](#), Air - aboard aircraft, Maritime - aboard ships, [Antarctica](#))

Common Talk-Group ID Numbers

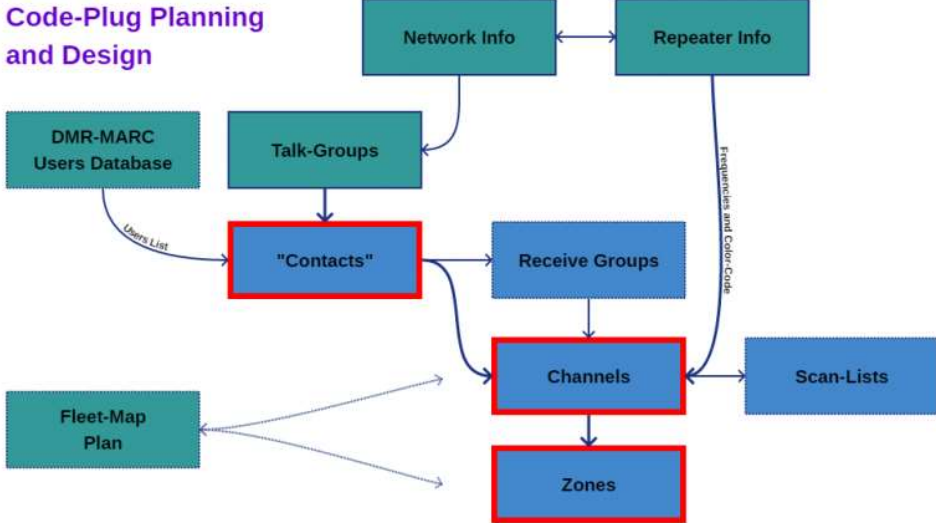
Minnesota = 3127

Iowa = 3119

Arizona = 3104

World Wide = 91

North America = 93



Common numbering plan

There are a few “americanizzums” on the “**MARC**” (Motorola Amateur Radio Club) networks... For example using TG1 or TG3 for World-Wide and Nation-Wide is basically ignoring the rest of the world by conflicting their numbering space.

Brandmeister is an International network and it wasn’t “invented here”... It tries to avoid the politics by being as open as possible and rejecting the notion of closed access... It’s willing to support any protocol or method if there’s an interest in **networking**... The Motorola IPSC protocol was reverse engineered when Motorola said if you want to know how it works, pay up and buy a license for every repeater that connects!

Format of numbers

Length of digits:

1-4 = Talk-Groups

5 = Links

6 = repeaters

7 = subscribers

8 = subscribers with extensions (hotspots)



Numbering details

Repeater IDs are 6 digits: XXXYWW

where XXX= Country (*)

Y= State/Province (or postal code where callsigns not assigned by state/province)

WW= Sequentially assigned repeater number

The US is a pretty big country so we have 310, 311, 312, 313, 314 and a few other non standard numbers with 31*

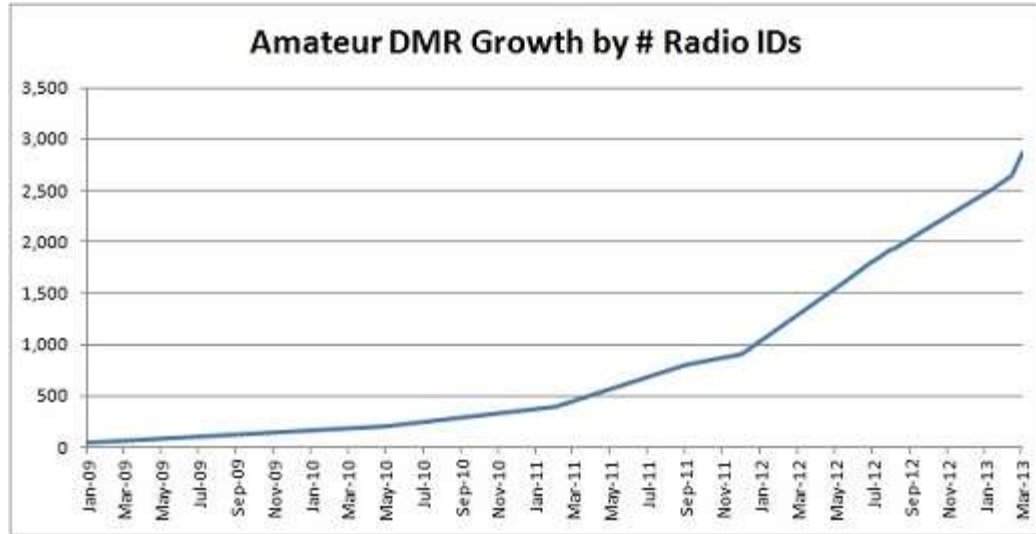
Subscriber IDs are 7 digits: XXXYZZZ

where XXX= Country (*)

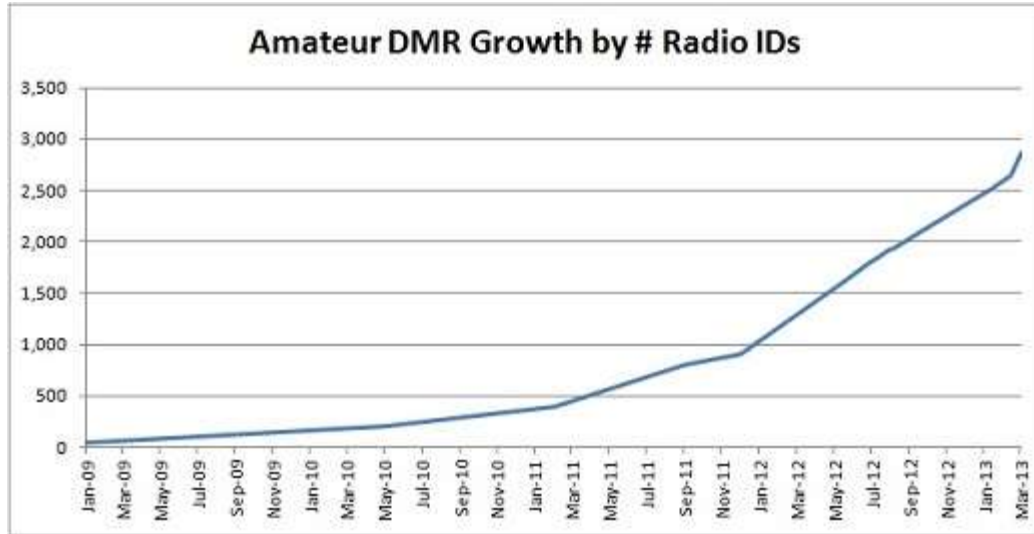
Y= State/Province

ZZZ= Sequentially assigned subscriber number

Guess how many subscriber ID numbers we have?



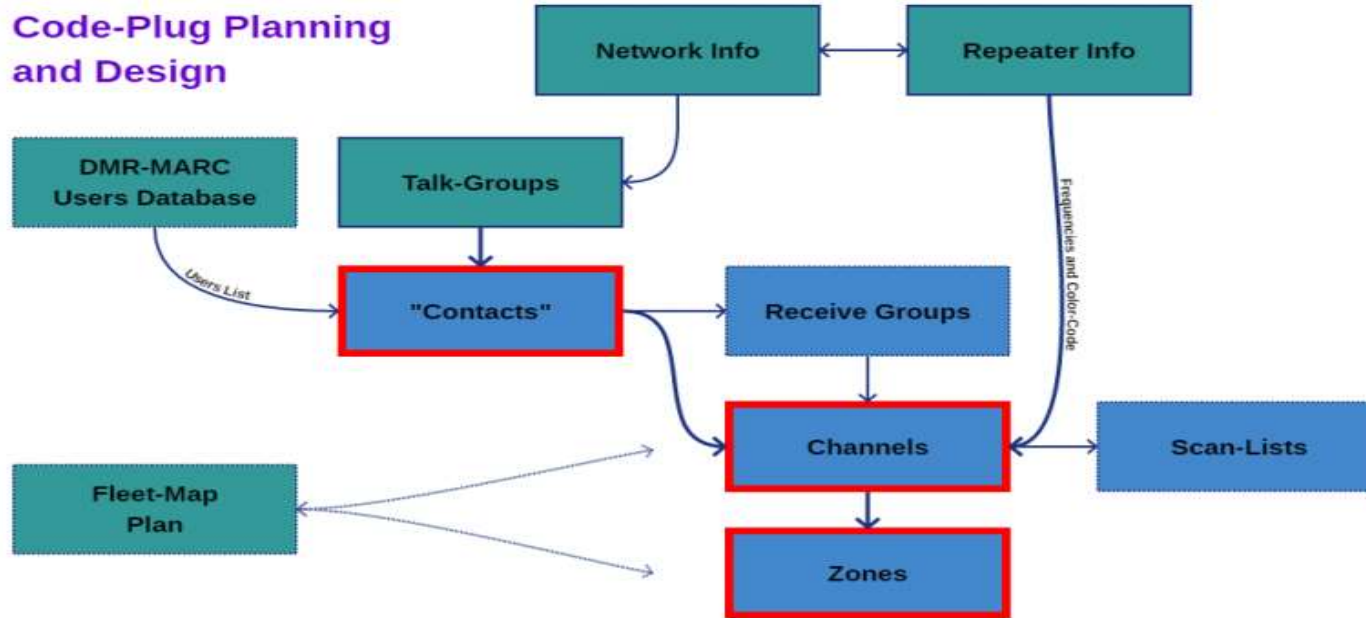
Last month we crossed >90,000!



OK, All that babbling is leading somewhere!

It's very important to have a plan before trying to program your radio.

Code-Plug Planning and Design



The Fleet Map

Very much like having an ICS-217A form ready to go.

What talk-groups do you want to use ?

What repeaters will you use with these talk-groups...

You should have a table with a layout for channels, zones and talk-groups...

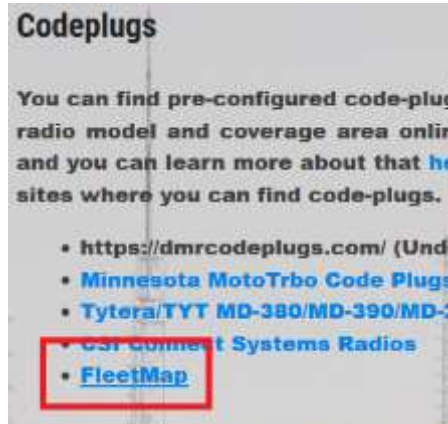
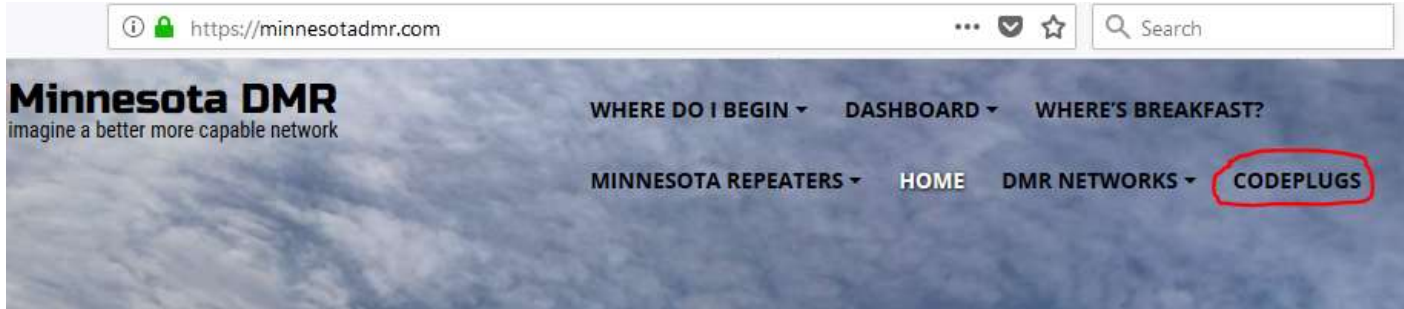
Zones are basically a folder... You can sort your channels/talk-groups any way you like... Do you want a folder(zone) for each talk-group and each channel within changes repeaters, or do you want a folder for each repeater?

ICS-217A

Incident Radio Communications Plan (ICS 205)

1. Incident Name: Midland Balloon Launch – MHS+NEMS – East Recovery Zone		2. Date/Time Prepared: Date: 6/1/2016 Time: 1800		3. Operational Period: Date From: 6/17/2016 Date To: 6/17/2016 Time From: 0800 Time To: 1600						
4. Basic Radio Channel Use:										
Zone Grp	Ch #	Function	Channel Name	Assignment	RX Freq N or W	RX Tone/NAC	TX Freq N or W	TX Tone/NAC	Mode (A, D, or M)	Remarks
East	1	Ground Coordination	Bay City Repeater	Ops/Recovery	145.31	131.8	144.71	131.8	A	
East	2	Ground Coordination	Saginaw Repeater	Ops/Recovery	147.24	103.5	147.84	103.5	A	
East	3	Ground Coordination	Hemlock Repeater	Ops/Recovery	145.33	88.5	144.73	88.5	A	
East	4	Ground Coordination	Midland Repeater	Ops/Recovery	147.00		147.60		A	
East	5	Balloon Tracking	MHS Balloon Fox Beacon	Ops/Recovery	146.40				D	300 mW output power
East	6	Balloon Tracking	NEMS Balloon Fox Beacon	Ops/Recovery	146.565				D	300 mW output power
East	7	Balloon Tracking	APRS Signal	Ops/Recovery	144.39				D	500 mW output power. APRS designate N8ERF-11 (NEMS balloon), W8MHS-11 (MHS balloon)
East	8	Ground Coordination	Launch Team Travel Comms	Ops/Recovery	146.45				A	simplex
5. Special Instructions:										
Use broad area coverage Bay City repeater, 145.31 – (131.8), unless notified otherwise.										
Open net will be run by Net Control Station (NCS), KBBUIH call, providing command and control instructions, and safety oversight										

Fleet Map examples



Dave's KEØNA FleetMap Example

https://drive.google.com/drive/folders/1C4oIuBnI-kGS6hRiBzT4DafCm5cHbje

DMR FleetMap 4-01-2018b.xlsx

Open with Google Sheets

NØNKI - MARC ID: #312723

BLM - Bloomington (443.100+ CC1 Brandmeister*)

Channel Number	Channel Name	Description	TG Number(s)
1	blm-LocalPwr	Local Repeater Only (TS2)	8
2	blm-Metro2_bln	Local Networked Repeaters, MTK, CSK, BLM & BLW (TS1)	31272
3	BLANK CH	Placeholder	
4	blm-MN State	Minnesota Repeaters (TS1)	3127
5	blm-Midwest	Midwest Repeaters (TS2)	3169
6	blm-NA_bln	North American Repeaters (TS1)	88
7	blm-WWE_bln*	Worldwide English Speaking Repeaters (TS2)	818
8	blm-WW_bln*	Worldwide Repeaters (TS2)	81
9	blm-COMM1*	Tactical Repeater to Repeater (TS2)	377215
10	blm-USA_bln*	Brandmeister USA (TS2)	3100
11	blm-WI State*	All Wisconsin Repeaters (TS2)	3155
12	blm-IA State*	All Iowa Repeaters (TS2)	3119
13	blm-RSA(DC_bln*	FEMA Region 5 AIRCOMM (TS1)	31673
14	blm-DMRPLK	DMR Simplex (448.075 MHz, CCL, TSL, 70) National Simplex	99
15	blm-BMRESET	Brandmeister Talk Group disconnect (TS2)	4000

Standard 16 Channel Zone

Additional Channels Beyond Standard 16 Channel Zone (for radios that support this)

Key

- * = PTT (Push To Talk, User Access)
- * = PTT Override NA (3 min T/O)
- CC = Color Code

*Brandmeister Network Connected



Tools

CPS = Customer Programming Software

Certain companies want lots of money or only support their dealers!

Motorola, available for about 350 bucks every three years.

Hytera, Available to dealers, often available from your dealer for ham use.

Tytera, Free with the radio or online

Kydera, Free with the radio, hard to find except with your radio... Updates, talk with your non-existent dealer. Weak support network

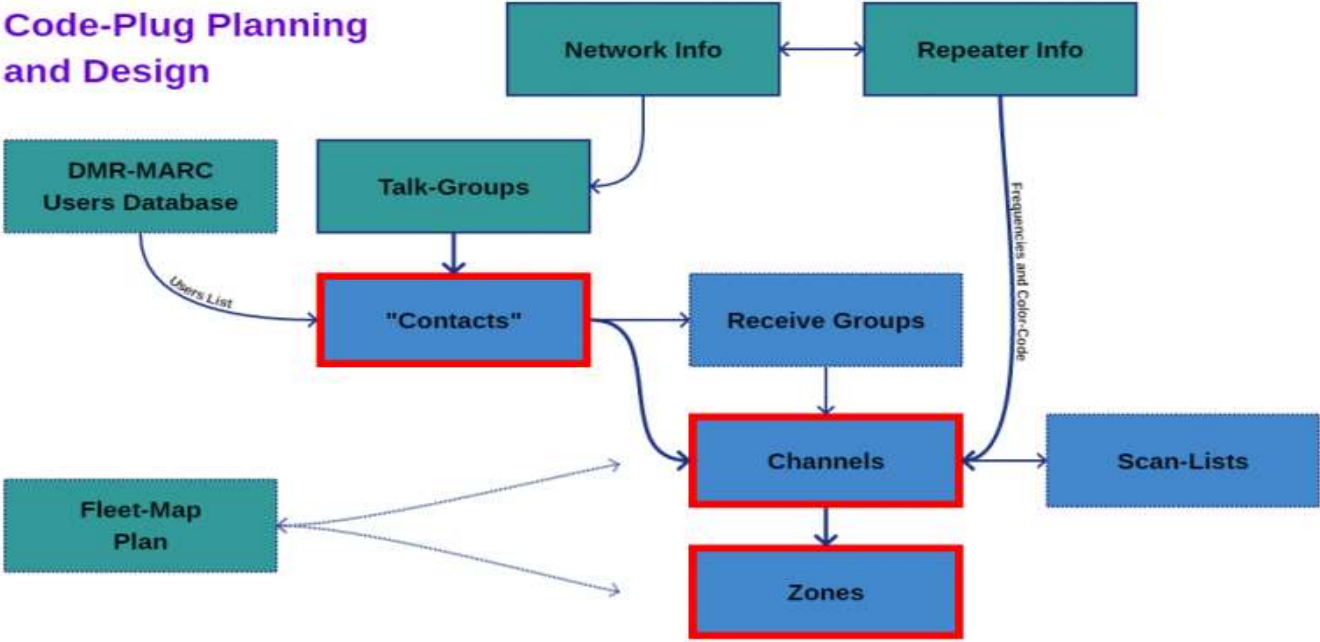
Anyone, Free with radio or online

MOTOROLA RADIO CODEPLUGS

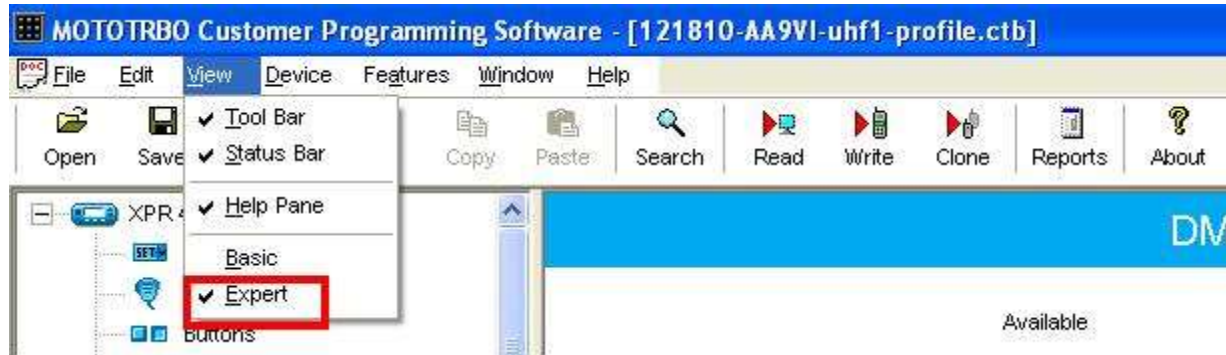
Putting it all together (MOTOROLA)

Once we know what we want, there's an order to plugging the details in...

Code-Plug Planning and Design



We start by enabling expert view



Start in general and put in our own ID and name

The screenshot displays the MOTOTRBO Customer Programming Software interface for an XPR 4550 device. The left sidebar shows a tree view of settings categories, with 'General Settings' selected. The main window shows the 'General Settings' configuration page, which includes tabs for 'Top', 'Microphone', 'Battery Saver', 'Alerts', 'Persistent LRRP Requests', 'Lone Worker', and 'Password and Lock'. The 'Radio Name' field is highlighted with a red box and contains the text 'KZ9GDO - Guido'. The 'Radio ID' field contains the value '3117999'. Other visible settings include 'GPS' (unchecked), 'Private Calls' (unchecked), 'ARS Initialization Delay (min)' (0), 'TX Preamble Duration (ms)' (960), 'Monitor Type' (Open Squelch), 'Unlink Monitor' (unchecked), 'Off-Hook Disables PL' (unchecked), 'Talkaround Group Call Hang Time (ms)' (3000), 'Talkaround Private Call Hang Time (ms)' (4500), 'TX Low Power (W)' (27.5), 'TX High Power (W)' (44.0), 'Disable All LEDs' (unchecked), and 'Codeplug Password' (empty).

We need contacts - Needed in next steps

The screenshot shows the MOTOTRBO Customer Programming Software interface. The left sidebar displays a tree view of settings, with the 'Contacts' folder highlighted. The main window shows a list of contacts under the 'Digital' tab. The first four contacts are highlighted with a red box:

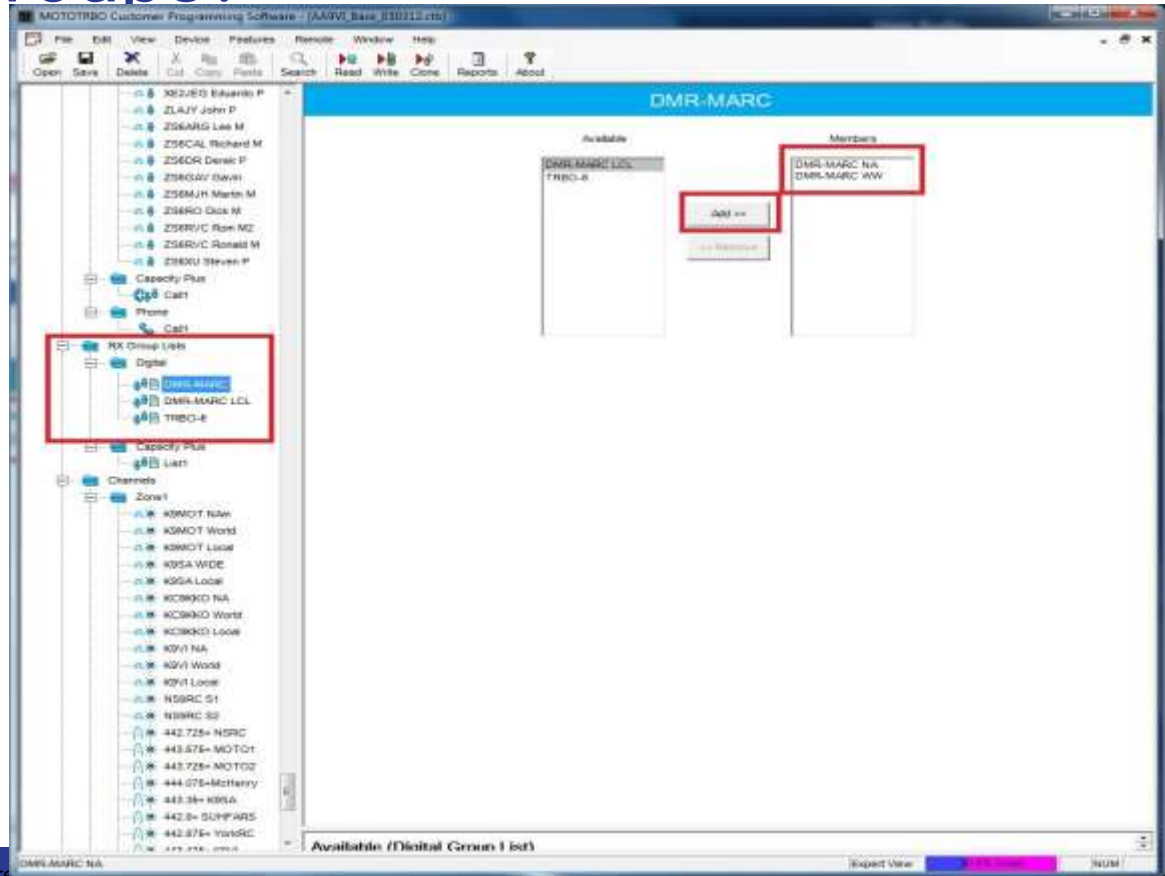
Contact Name	Cell ID	Call Receive	Ring Style	Text Message Alert Tone
DMR-MARC WW	1	<input type="checkbox"/>	No Style	Repetitive
DMR-MARC NA	3	<input type="checkbox"/>	No Style	Repetitive
DMR-MARC LCL	2	<input type="checkbox"/>	No Style	Repetitive
TRBO-E	377215	<input type="checkbox"/>	No Style	Repetitive

Remember RX Groups?

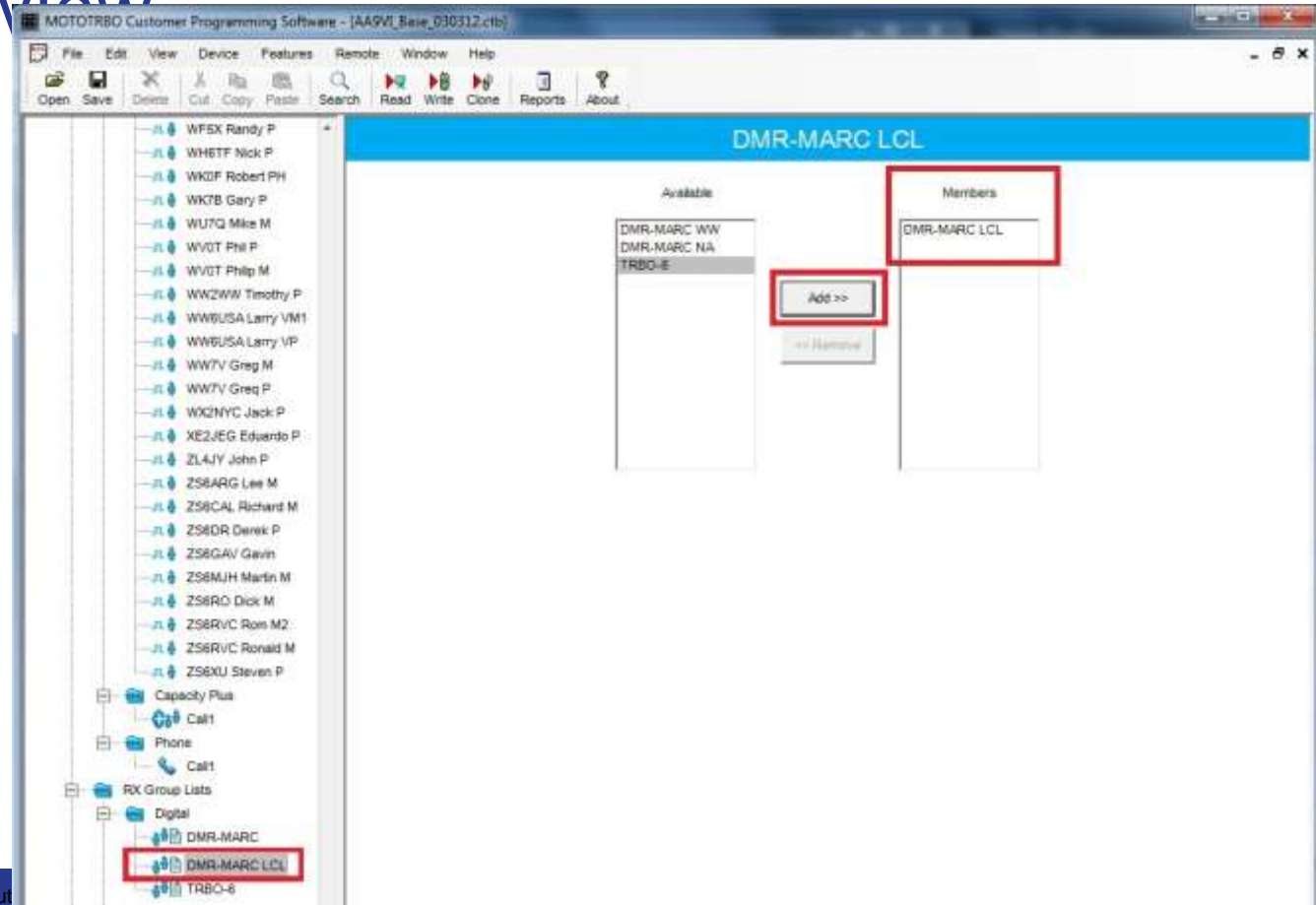
Some radios need these.

Even if they only contain 1
Talk-group (contact)

Yup, you guessed it, we
Need these for the next
step



Just another view



Scan lists

We need a list of things to scan, (Channels) for when we program channels...

Egg Meat Chicken... No that's not right?

Egg, Meet Chicken!

Horse met buggy ?

OK, we need the list, but the list can be empty... Or maybe we don't need the list?

Getting to the Channels

- Scan List
- Color Code
- Time-Slot
- ARS

MOTOTRBO Customer Programming Software - [AA9VL_Base_030312.ctb]

File Edit View Device Features Remote Window Help

Open Save Delete Cut Copy Paste Search Read Write Clone Reports About

XE2JEG Eduardo P
ZL4JY John P
Z56ARG Lee M
Z56CAL Richard M
Z56DR Derek P
Z56GAV Gavin
Z56MUH Martin M
Z56RO Dick M
Z56RVC Ron M2
Z56RVC Ronald M
Z58XU Steven P

Capacity Plus
Call1
Phone
Call1
RX Group Lists
Digital
DMR-MARC
DMR-MARC LCL
TRBO-6
Capacity Plus
List1
Channels
Zone1
K9MOT NAM
K9MOT World
K9MOT Local
K9GA WIDE
K9SA Local
K9KKO NA
K9KKO World
K9KKO Local
K9VI NA
K9VI World

K9MOT NAM

Top RX TX

Scan/Room List Scan List

Auto Scan

Color Code 1

Repeater Slot 1

Phone System None

ARS Disabled

Enhanced GPS

Window Size

Privacy

Privacy Alias Privacy Key1

Option Board

Option Board Trunking

Lone Worker

Allow Talkaround

IP Site Connect

Messaging Delay (ms) 60

Compressed UDP Data Header

RX Only

RX TX

- Frequencies
- RX-Groups
- Contacts
- Power Level
- TOT

MOTOTRBO Customer Programming Software - [AA5VJ-website-demo.cfb]

File Edit View Device Features Remote Window Help

Open Save Delete Cut Copy Paste Search Read Write Clone Reports About

K9MOT World

Top BX TX

IP Site Connect

Messaging Delay (sec) 90

Compressed UDP Data Header

RX Only

RX

Frequency (MHz) 444.793750

Ref Frequency (MHz) Default

Group List DMR-MARC

Emergency Alarm Indication

Emergency Alarm Ack

Emergency Call Indication

TX

Frequency (MHz) 444.793750

Ref Frequency (MHz) Default

Contact Name DMR-MARC WA

Emergency System None

Voice

Power Level High

TOT (sec) 180

TOT Relay Delay (sec) 0

Allow Interruption

TX Interruptible Frequencies

Admit Criteria Color Code Free

In Call Criteria Follow Admit Criteria

RSSI Threshold (dBm) -124

GPS Revert Selected

Private Call Confirmed

Data Call Confirmed

Enhanced Channel Access

Offset (MHz) 5.000000

Copy

TX Interruptible Frequencies

This feature needs to be enabled if the frequency supports interruptible voice transmissions. For frequencies supporting direct mode

Expert View **Full Control** NUM

K9MOT World

Admit Criteria:

- **Color Code Free**
(Your own repeater says the time-slot is available for you)
- **Always**
(Transmit away, don't care what's out there)
- **Channel Free**
(No RF Received)

Zones Again

With Motorola, you begin by creating your channels in a folder known as a Zone.

With other radios, you need to create your zones after creating your channels...

Motorola might require you to copy your channels if you wanted them to appear in more than one zone... Another downside to Moto gear? Maybe I overlooked something.



Knobs! - There's so many of them....

You may have noticed a ton of options in your software. Remember you are in expert mode but might not be an expert. Please don't attempt to change things you do not yet understand. **You don't need to change every setting to make your radio work!**

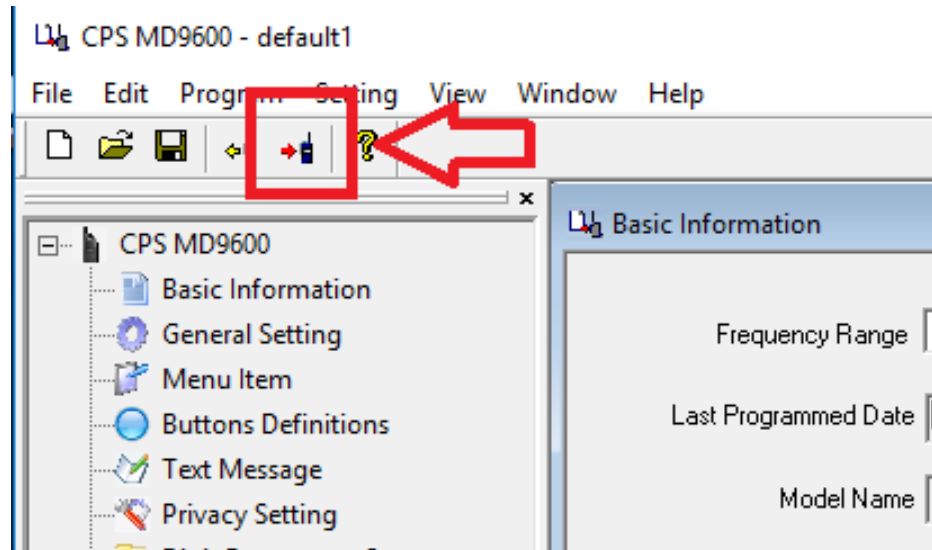


TYT / Tytera Radio CPS

Open the software and read your radio

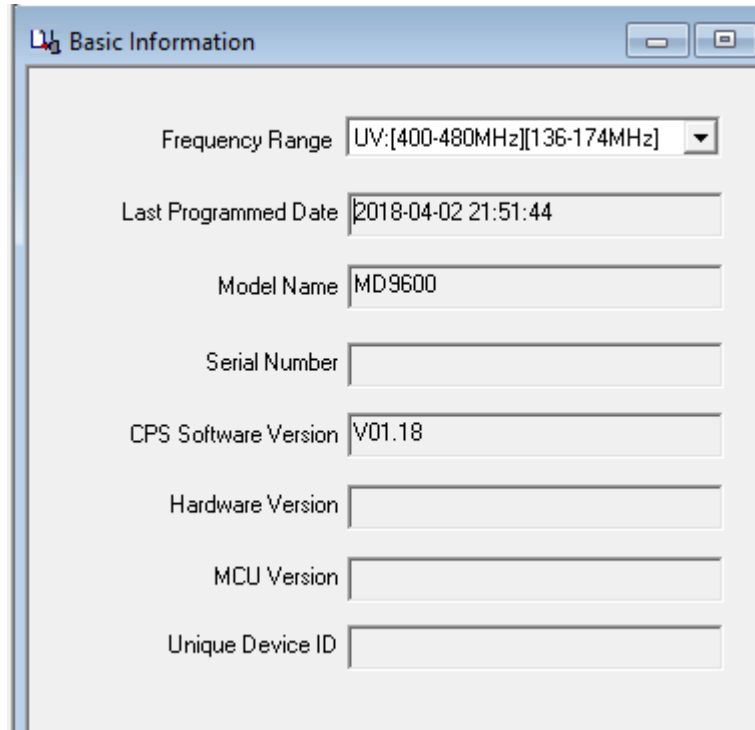
Always read your radio and make a backup copy!!!!

Even on the brand new radio... Save this file!



Basic Information

Read Only info...



The screenshot shows a window titled "Basic Information" with the following fields:

Frequency Range	UV:[400-480MHz][136-174MHz]
Last Programmed Date	2018-04-02 21:51:44
Model Name	MD9600
Serial Number	
CPS Software Version	V01.18
Hardware Version	
MCU Version	
Unique Device ID	

General Settings

Radio Name = Call Sign

Radio ID = 3127XXX

No need to change settings
We have not talked about...

General Setting

Alert Tone

- Disable All Tone
- CH Free Indication Tone
- Talk Permit Tone: None
- Call Alert Tone Duration[s]: Continue

Scan

- Scan Digital Hang Time[ms]: 1000
- Scan Analog Hang Time[ms]: 1000

Lone Worker

- Lone Worker Response Time[min]: 1
- Lone Worker Reminder Time[s]: 10

Power On Password

- Password and Lock Enable
- Power On Password: 00000000

Radio Name: []

Radio ID: 1234

Monitor Type: Open Squelch

VOX Sensitivity: 3

TX Preamble Duration[ms]: 600

RX Low Battery Interval[s]: 120

Channels Hang Time[ms]: 3000

PC Programming Password: []

Radio Program: []

Back Light Time[s]: Always

Set Keypad Lock Time[s]: Manual

Freq/Channel Mode: Channel

Model Select A: MR

Model Select B: MR

Time Zone: UTC +8:00

Group Call Match

Private Call Match

Talkaround

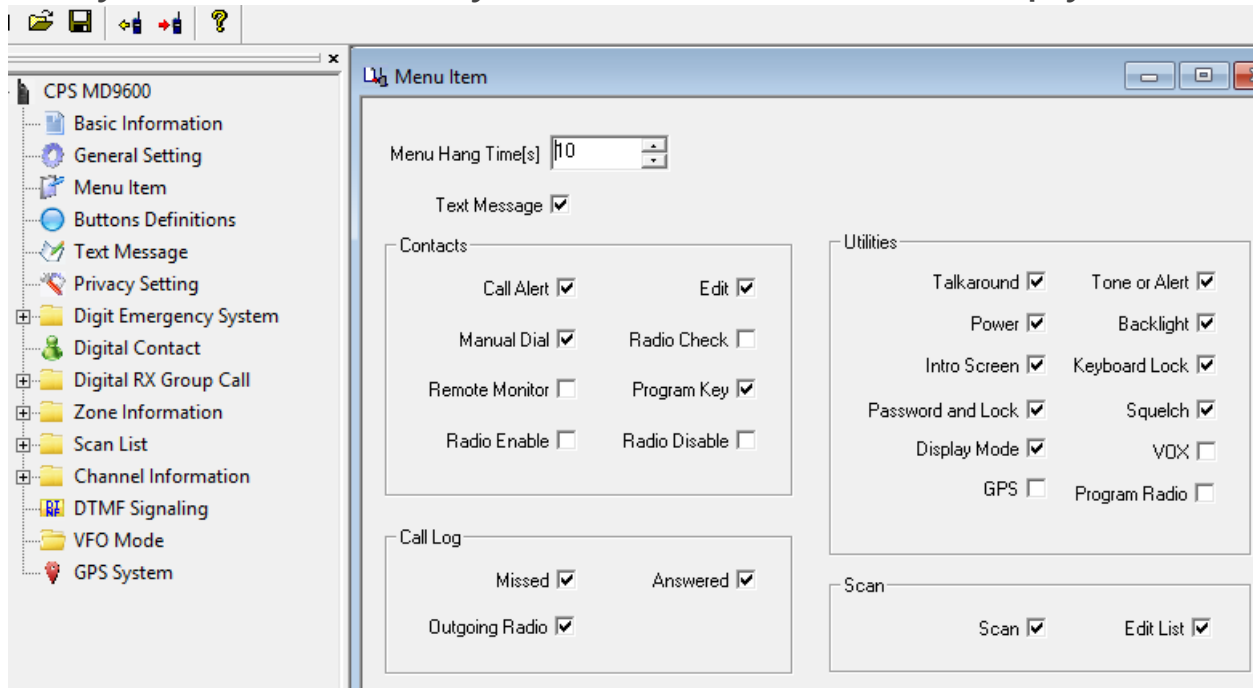
- Group Call Hang Time[ms]: 3000
- Private Call Hang Time[ms]: 4000

Intro Screen

- Intro Screen: Picture
- Intro Screen Line 1: []
- Intro Screen Line 2: []

Menu item...

Basically what menus do you want on the radio, simply check the box



Set buttons as you wish

Buttons Definitions

Long Press Duration[ms] 1000

Radio Buttons

	Short Press	Long Press
P1	Unassigned (default)	Unassigned (default)
P2	Unassigned (default)	Unassigned (default)
P3	Unassigned (default)	Unassigned (default)
P4	Unassigned (default)	Unassigned (default)

One Touch Access

No.	Mode	Call	Call type	Message/Encode
1	Digital	Contact1	Text Message	Hello
2	Digital	Contact1	Text Message	Hello
3	Digital	Contact1	Text Message	Hello
4	Digital	Contact1	Text Message	Hello
5	Digital	Contact1	Text Message	Hello
6	Digital	Contact1	Text Message	Hello

Number Key Quick Contact Access



Let's talk about business features!

STUN & Remote Monitor

The screenshot displays the configuration interface for a Digit Emergency System. On the left, a tree view shows the system structure, with 'System1' selected under the 'Digit Emergency System' folder. The main window shows the configuration for 'System1'. A red box highlights the following options:

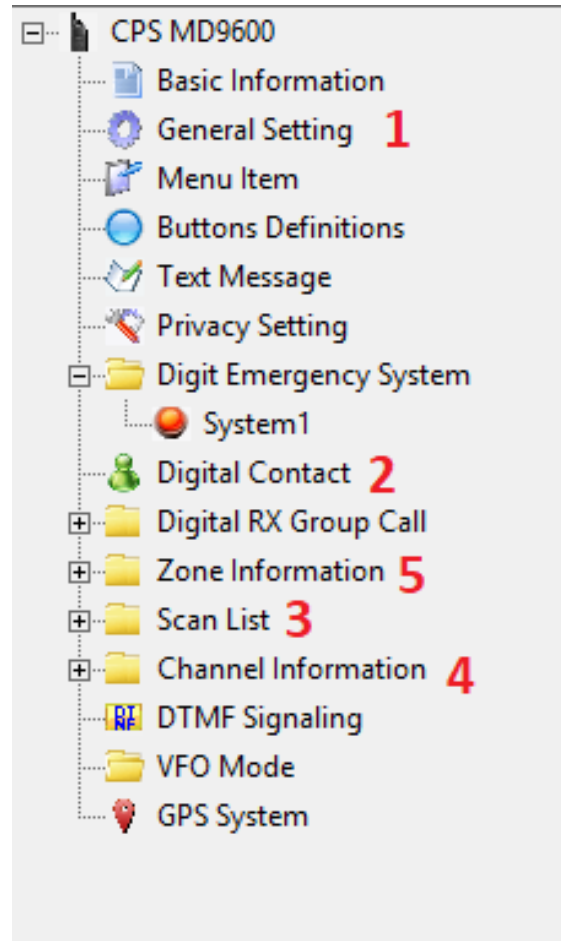
- Radio Disable Decode
- Remote Monitor Decode
- Emergency Remote Monitor Decode

Other configuration options include:

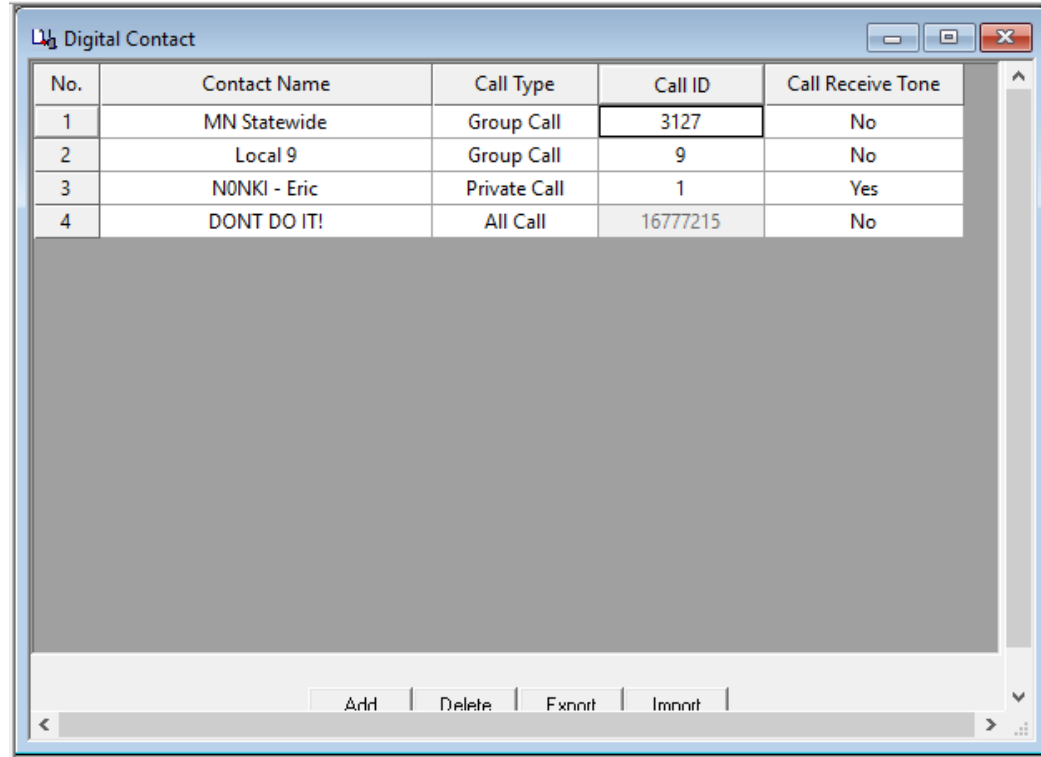
- Remote Monitor Duration[s]: 10
- Tx Sync Wakeup TOT[ms]: 150
- Tx Wakeup Message Limit: 3
- Emergency System:
 - System Name: System1
 - Alarm Type: Regular
 - Alarm Mode: Emergency Alarm
 - Revert Channel: None
 - Impolite Retries: 15
 - Polite Retries: 5
 - Hot Mic Duration[s]: 10

OK, a little more focus here:

1. Set your radio ID and Callsign in radio name
2. Enter all your contacts (Talk-Groups)
3. Create your scan lists (names at least)
4. Enter your channels
5. Put your channels into a zone



2) Digital Contacts



The screenshot shows a window titled "Digital Contact" with a table containing four rows of contact information. The table has five columns: "No.", "Contact Name", "Call Type", "Call ID", and "Call Receive Tone". The rows are as follows:

No.	Contact Name	Call Type	Call ID	Call Receive Tone
1	MN Statewide	Group Call	3127	No
2	Local 9	Group Call	9	No
3	NONKI - Eric	Private Call	1	Yes
4	DONT DO IT!	All Call	16777215	No

At the bottom of the window, there are buttons for "Add", "Delete", "Export", and "Import".

3) Scan Lists

Scan List

Scan List Name:

Available Channel	Channel Member
<div style="border: 1px solid gray; height: 150px;"></div>	<div style="border: 1px solid gray; height: 150px; text-align: center;">Channel1</div>

Priority Channel 1: Signaling Hold Time[ms]:

Priority Channel 2: Priority Sample Time[ms]:

Tx Designated Channel:

1 of 1

4) Enter Channels

Channel Information

Digital/Analog Data

Channel Mode: Digital Channel Name: MNStateBLM

Band Width: 12.5kHz RX Frequency(MHz): 443.10000

Scan List: SomeNewLi TX Frequency(MHz): 448.10000

Squelch: Normal Admit Criteria: Always

RX Ref Frequency: Low Auto Scan:

TX Ref Frequency: Low Rx Only:

TOT(s): 390 Lone Worker:

TOT Retry Delay(s): 0 VOK:

Power: High Allow Talkaround:

Send GPS Info:

Receive GPS Info:

Digital Data

Private Call Confirmed:

Emergency Alarm Ack:

Data Call Confirmed:

Allow Interrupt:

DCDM Switch:

Location: MS

Emergency System: System1

Contact Name: MN Statewide

Group List: GroupList

Color Code: 1

Repeater Slot: 1

In Call Criteria: Always

Privacy: None

Priority No: 1

GPS System: None

Analog Data

CTS/DCE Pwr: None CTS/DCE Linc: None

Rx Signaling System: OE Tx Signaling System: OE

DC Reverse: TR0 RevDT/DT1 Format Pwr: None

Display PTT ID Reverse Scan/Insert Code

1 of 1

Back Home Add Delete Export Import

5) Create a zone

Zone Information

Zone Name

Available Channel	Channel Member A	Available Channel	Channel Member B
Channel1	MNState.BLM	MNState.BLM Channel1	

1 of 1 <- << >> -> Add Delete

Save the codeplug as a file

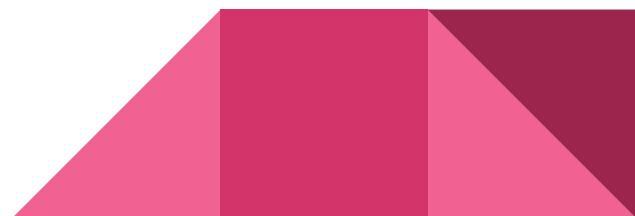


Write to the radio

You already read the radio and made a backup (saved to a file!)... Right!



Try it out!



3rd party tools to try

MD380/MD390:

<https://www.farnsworth.org/dale/codeplug/editcp/>

<http://www.miklor.com/MD380/380-CPEditor.php>

<http://n0gsg.com/contact-manager/>



Nearly the end

Out of materials for now!

