INTRODUCTION TO DMR

by KG5ZNJ (Frank)

Introduction

The purpose of this presentation is to give the new DMR user a good understanding of the basic building blocks and concepts of DMR Radio.

DMR has somewhat of an up front learning curve compared to other modes, and this presentation will help a new user get through it without too much frustration.

Why bother with Digital FM ?

- There are always QSO's to be made 24/7/365 on Digital FM.
- You can work the entire world with a Technician License.
- Not affected much by the Solar Cycle or Band Conditions.
- Greater distance than analogue because bandwidth is more narrow.
- No loss of signal quality with Digital.
- Equipment is minimal and inexpensive.
- Very easy to take along while travelling.
- Can be used anywhere.
- Just about any digital radio will also do traditional analogue.

Why chose DMR ?

- DMR Radios are generally much cheaper than D-Star or System Fusion radios.

- DMR's encoding uses up to 40% less battery compared to other digital modes.

- Uses open standards. This means anyone can build DMR Radios without licensing, and the R&D is already done (less costs to recoup).

- DMR radios are typically rebranded or slightly modified commercial radios so you benefit from the Economies of Scale.

- DMR is the fastest growing FM digital mode and also has the most users.

What is DMR?

Digital Mobile Radio (DMR) is a specification released by the European Telecommunications Standards Institute (ETSI) in the 1990s, which is now heavily used in **commercial radios** around the world.

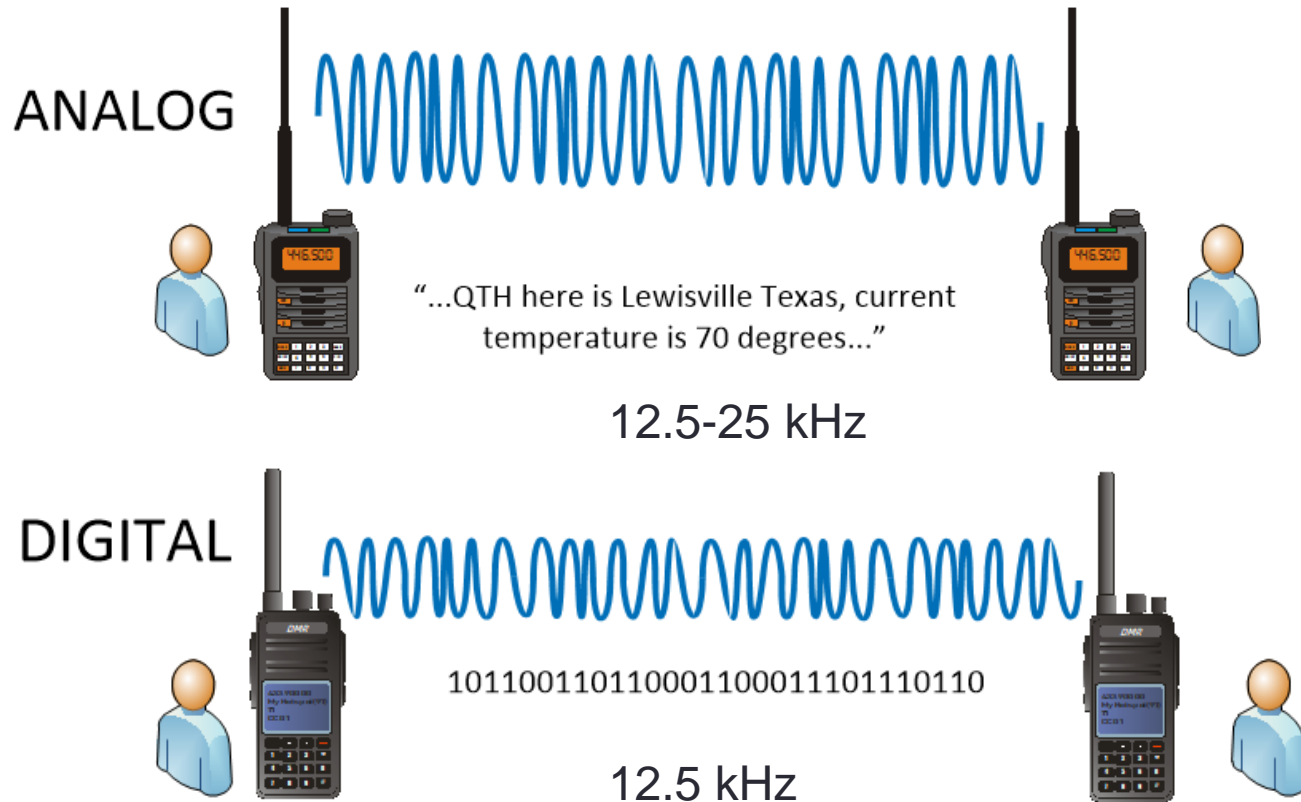DMR has been adapted for use in Amateur Radio in recent years, **but it was not created for that purpose**.

DMR is used in Amateur Radio on VHF & UHF frequencies.

Why is DMR so confusing to hams ?

 DMR did not come from, not was it created for HAM radio. It is a very different animal than other HAM radio modes, so it can be very difficult to get a solid understand of what's going on, how it works and how one can use it.

With proper explanation, DMR is actually quite easy to figure out and use. Once things are set up properly, it isn't any harder than picking a channel and using the PTT button.

Analog vs Digital Simplex

ANALOG

"...QTH here is Lewisville Texas, current temperature is 70 degrees..."

12.5-25 kHz

DIGITAL

1011001101100011000111011110110

12.5 kHz

DMR User ID

The first thing you need is DMR user ID.   If you plan on just using simplex, radio to radio, you could just make one up.

If you ever plan to use a DMR Hotspot, Repeater or DMR Network, you need an official unique User ID. Apply for one here:
https://radioid.net/

It is free, but you do need a valid amateur radio callsign (Technician License).

The DMR User ID

3131495 (KG5ZNJ DMR ID)

DMR IDs are **7-digits** long, with the first three digits designating the country, the fourth digit designates the province, state or region and the last three digits designate the user in that particular area.

There are special **5-digit** numbers for portable radios using Motorola Capacity Plus.

DMR Repeaters use **6-digit** numbers.

The DMR ID is simply there to identify you as the user when you are traversing DMR networks.

Add the DMR ID to your Radio

Before doing anything with DMR, you should add your DMR ID to your radio.

Requirements for a DMR Contact

At a minimum, a Digital DMR contact requires a channel defined with a four parameters:

1. Frequency
2. Timeslot (TS)
3. Color Code (CC)
4. Talk Group (TG)

A Simplex Radio to Radio Contact

Frank's Radio

Channel 1 setup:
Frequency   : **441.000 MHz**
Timeslot(TS)   : **1**
Color Code(CC) : **1**
Talkgroup(TG) : **99**

Rons' Radio

Channel 5 setup:
Frequency   : **441.000 MHz**
Timeslot(TS)   : **1**
Color Code(CC) : **1**
Talkgroup(TG) : **99**

Since the frequency and three DMR parameters match, this contact will work.

Simplex Contact cont.

Frank's Radio

Channel 1 setup:
Frequency   : **441.000 MHz**
Timeslot(TS)   : **1**
Color Code(CC) : **1**
Talkgroup(TG)   : **99**
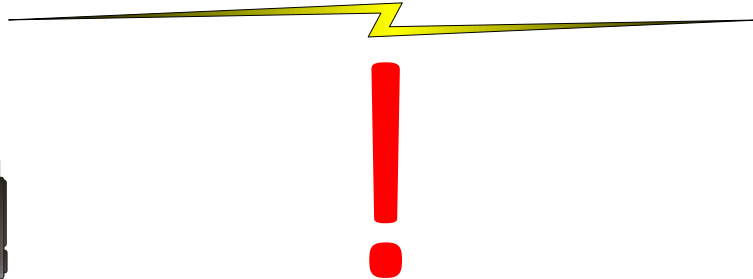
Rons' Radio

Channel 5 setup:
Frequency   : **441.000 MHz**
Timeslot(TS)   : **2**
Color Code(CC) : **5**
Talkgroup(TG)   : **78**

Despite being on the same frequency, **all three DRM parameters** must be the same for the contact to work.

DMR Parameters

So what are these strange DMR parameters:
- **Timeslot**
- **Color Code**
- **Talk Group**

Lets explain them one at a time!

What is a Time Slot ?

A DMR transmission is broken into two "time slots" and can handle two different transmissions over the same frequency at the same time.

You have to pick either Timeslot 1 or 2.

Timeslot: [1-2]

How is that possible ?
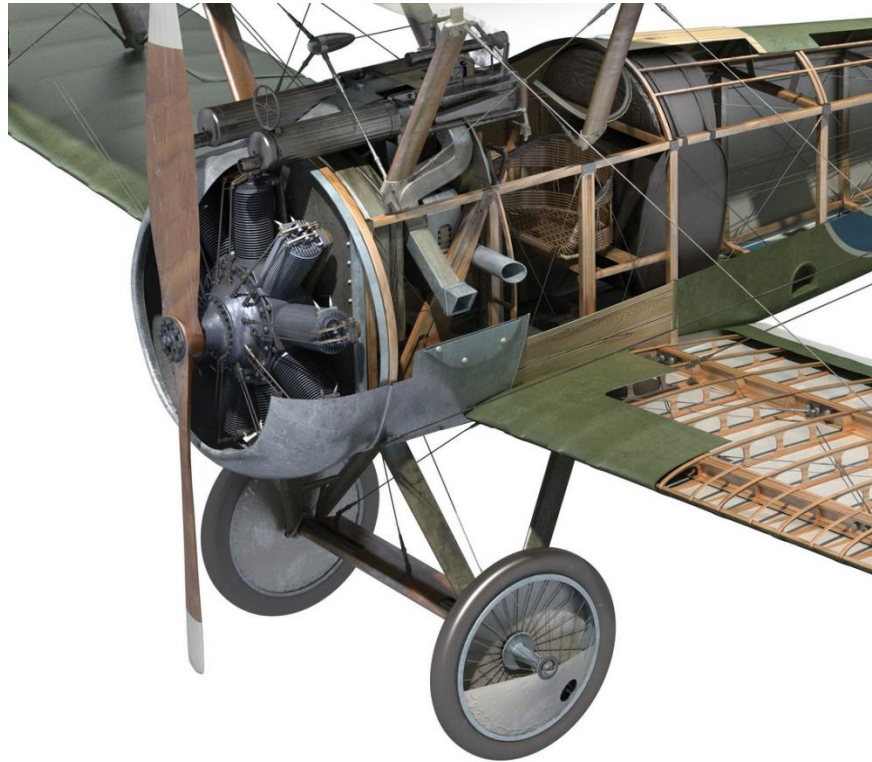
A DMR timeslot is kind of like a World War I fighter with two machine guns firing through a propeller. It's all about the timing !

How is it done ?

DMR uses a technology called Time Division Multiple Access (**TDMA**).

A transmission is broken down into **alternating 30 millisecond bursts**. Think of this as very rapidly pressing your PTT button on and off at 30 millisecond intervals.

A 2nd user could do the same, but alternate the spacing so that he is transmitting when you are not (and vice versa).

Using this technique, two users can use the two different timeslots, with the digital signals being split apart at the source radio, and re-assembled at the destination radio without anyone stepping over anyone. DMR does it all automatically.

This is possible to do because the human ear cannot detect a 30 millisecond gap in Audio Frequency - it's just too fast to notice !

Timeslot: 1
441.000 MHz

Frank

Ron

Timeslot 1	Hello	this	is	Frank	how	are	you ?
Timeslot2	Did	you	see	the	game	yesterday?	

Timeslot: 2
441.000 MHz

Jeff

Bill

What is a Color Code ?

A color code has nothing to do with colors. It is a numerical value between 0 and 15, and is simply used like digital CTCSS Squelch code.

In short, if you want to hear a transmission, your color codes must match, and there are 16 values to pick from.

Color Code [0-15]

What is a Talk Group ?

A Talk Group is simply a number between 1 and 99999 that is encoded into the transmission.

This allows users to categorize and listen for certain transmissions while ignoring other transmissions.

You can think of a Talk Group as chat room. Anyone connected to the same Talk Group will be able to talk to each other.

Talk Group [1-99999]

Oh and….

Instead of using a **Talk Group** number, you can use a DMR **UserID** number to talk to a specific user.   This is known as a **Private Call**.

DMR also supports full encryption, but this is against the rules in the USA. You can use this feature in certain countries (Canada).

DMR Repeaters

A DMR repeater will have the typical frequency offsets found on an analogue repeater.   You will need to know the timeslot, color code and what Talk Groups are available to set up your channel.
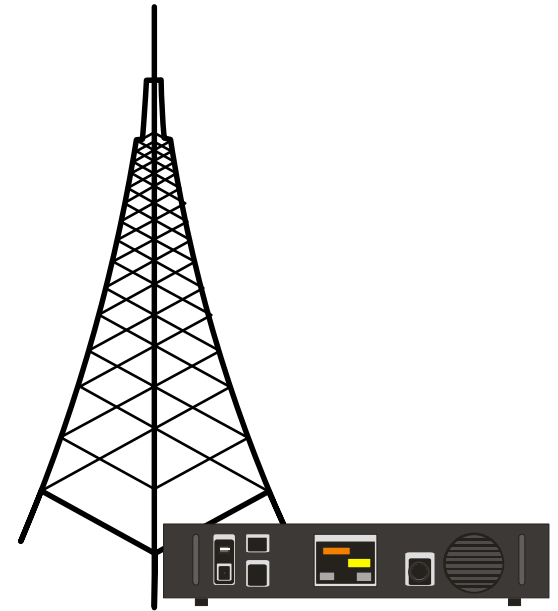
Fictional Example of a very simple DMR Repeater
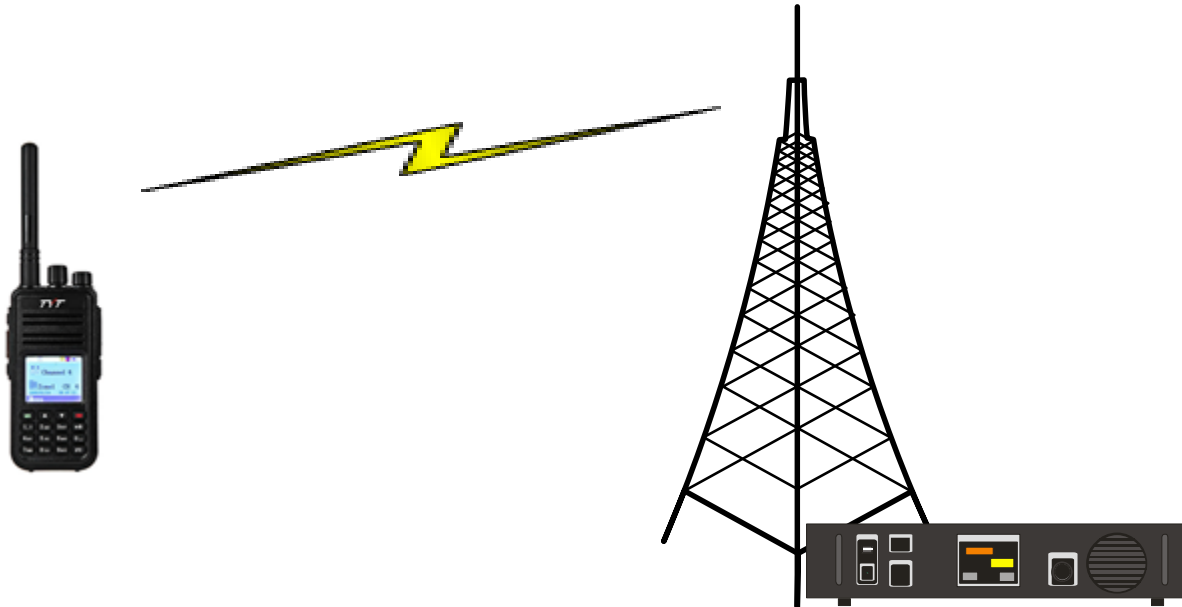
Frequency   :**440.1000** (+5MHz offset)
CC code   :**2**
Timeslot   :**1** [Talk Groups:**2**(Metro), **11** (Skywarn)]
Timeslot   :**2** [Talk Groups:**15**(Radio Club), **16** (Field Day)]

The Internet

Note that up to now, there is no internet in the picture. It is a common misconception that DMR will not work without the Internet.

DMR was designed without the internet in mind. It is used today for commercial radio systems, and also by many Police, Fire and Emergency Services.

HAMs do use VOIP **DMR Networks** on the Internet to link DMR systems together across long distances.

DMR Networks

DMR Networks are internet VOIP networks that connect DMR systems together.

Lewisville TX, USA   DMR Network   New York City NY, USA
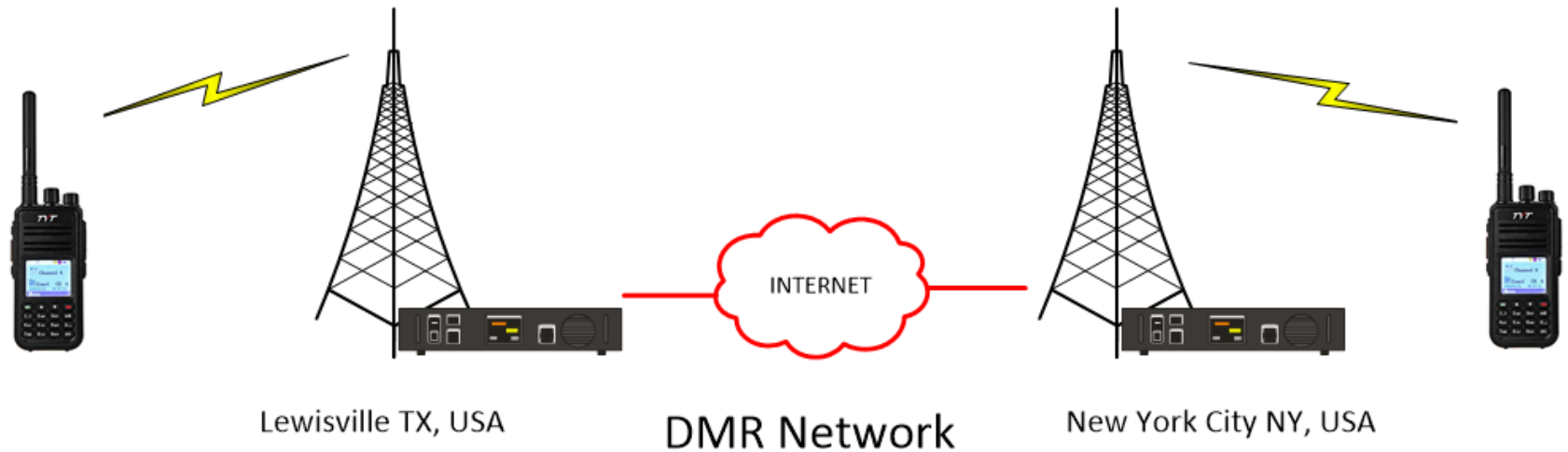
In this example, only the DMR Network and the Talk Groups are common between these two repeaters.

Remember!

A DMR Radio does not use the Internet, and has no way to connect to a DMR Network on it's own.

The Internet only comes into play if a Repeater or Hotspot has an Internet connected DMR network on the back end.

There are now DMR applications you can run on a PC or smart phone that tap directly into DMR networks.

New advances are being made all the time !

DMR Networks

Popular DMR Networks:

- **DMR-MARC**
- **C-Bridge**
- **Brandmeister**
  (*and others*)

DMR Network Talk Group numbers are unique inside a given network (typically), but certain TGs can be bridged between networks.

A Real World Repeater attached to a DMR Network

Denton, TX - 440.66250MHz, CC1 - CBridge 2.0

Timeslot 1		Timeslot 2	
Talkgroup Name	Talkgroup ID (PTT)	Talkgroup Name	Talkgroup ID (PTT)
Texas Statewide	3148	Metro	2
Worldwide	1 (15)	Southern Plains	3175
North America	3 (15)	DCI Bridge	3100 (15)
Worldwide English	13 (15)	BM TG 3148 Link	9000 (15)
TAC310	310 (15)		
BronxTRBO (NYC)	444		

Frequency   :**440.66250** (+5.0 MHz),
Color Code   :**1**
Timeslot 1   :Talk Groups **3148, 1, 3, 13, 310, 444**.
Timeslot 2   :Talk Groups **2, 3175, 3100 and 9000**.
DMR Network   :**CBridge 2.0**

The Hotspot

Hotspot Device

A Hotspot is a small low power digital radio Internet gateway device. It takes your digital RF signal, and converts it to VOIP and streams it over the Internet to a DMR Network (usually Brandmeister). It can be bought as a finished product, or can be constructed out of a Raspberry Pi with a 3rd party RF Modem daughterboard and antenna. You can use a hotspot in place of a Repeater to directly access a DMR Network.

The Hotspot
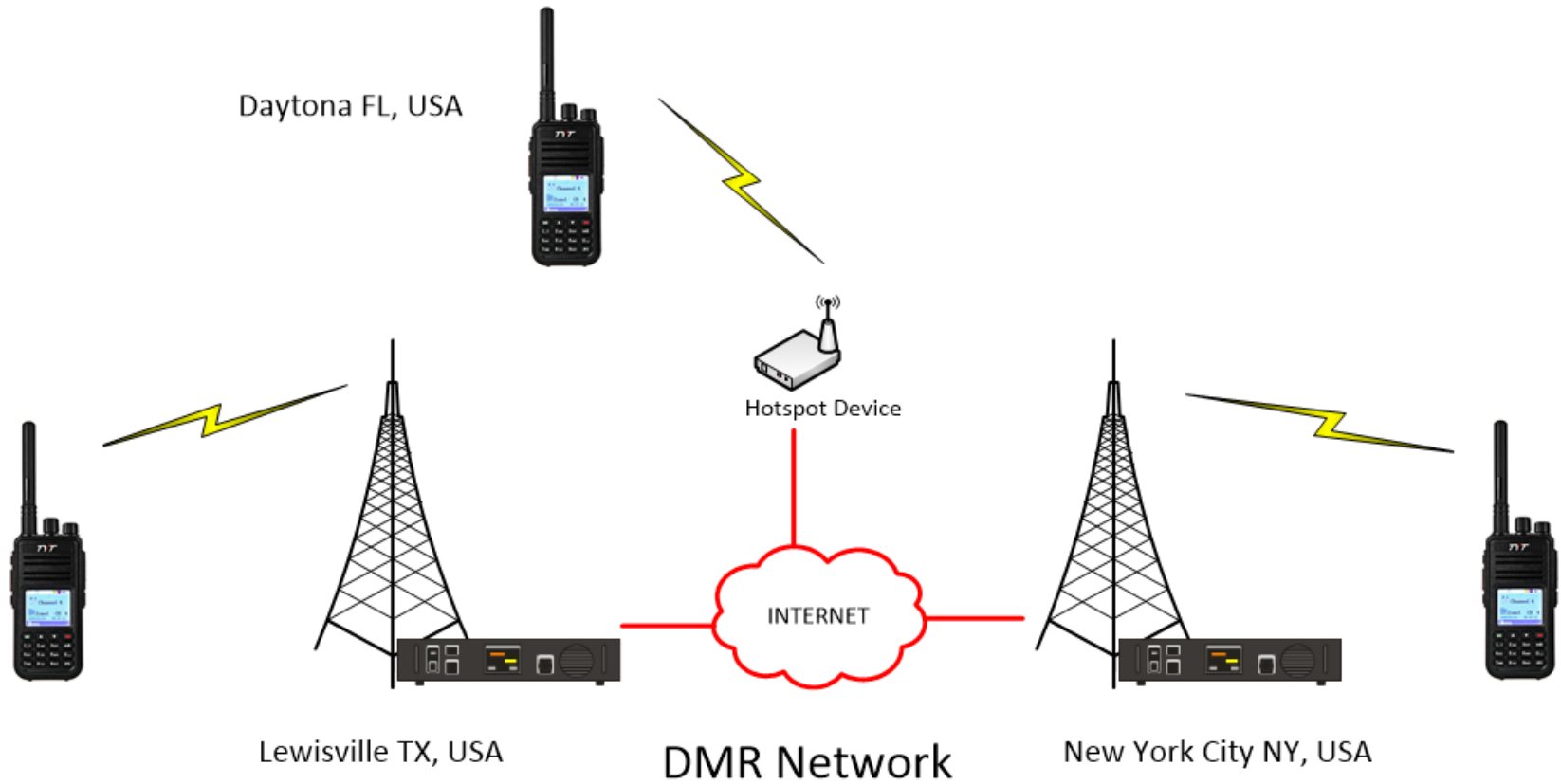
Promiscuous Mode

You may come across this DMR term. It's basically a setting on your radio that allows you to hear activity on one or both timeslots. You will still only transmit to the Talk Group that is programmed on your current channel.

Non Promiscuous Mode means you only hear activity on your current Talk Group/channel.

Dynamic vs Static Talk Groups

On certain DMR Networks, if you connect to a Talk Group using PTT (on the fly), you will be in what is called Dynamic Mode.   This means that you will automatically log out of the Talk Group after a certain amount of time (15 minutes) unless you are active.

Static means you have configured it so you are always "logged in" to a Talk Group. This is set on the repeater, or hotspot.

The Brandmeister Network

The most popular DMR Network in the world is the Brandmeister Network.

If you have a hotspot and will use it for DMR, you will want to connect to Brandmeister.

You need to create a free Brandmeister account, and get a login and password for your hotspot to connect to the Brandmeister Network.

https://brandmeister.network/?page=register

Popular Brandmeister Talk Groups

Very popular Talk Groups on Brandmeister include:

- 91 (World) – for short international QSOs.
- 310-320 (TAC Groups) – for ragchews.
- 3148 (Texas). Every state has a Talk Group.

There are Talk Groups for every country and region

You can monitor activity on Brandmeister by Talk Group here in real time:
https://brandmeister.network/?page=lh

Setting up DMR Radios

DMR Radios generally come in a commercial radio format and are basically blank.

You must program them from a PC (Windows) and upload the code to the Radio via USB Cable.   This uploaded code is called a "**Codeplug**".

You can also program some DMR radios from the keypad, but it is very difficult. Programming from a PC isn't much harder than using Chirp.

You can download a local codeplug from the web if you don't want to learn to program a DMR radio.

DUDE-Star

If you want to try DMR from a PC or Laptop, you can download DUDE-Star. All you need is a PC compatible headset and mic and you are good to go. It works great and is very easy to get up and running:

https://github.com/nostar/dudestar/releases
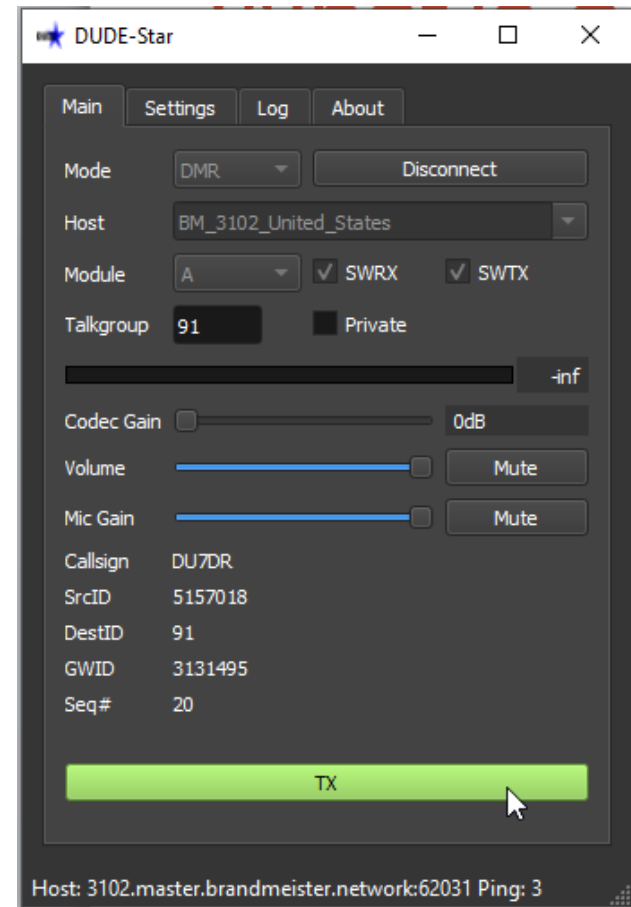
Where to get more information

Lee Norup's <u>Digitally Speaking Net</u>
Sunday 2pm – 3pm CST
146.920- tone:110.9
DCARA W5NGU Repeater
(this is an analog net)

Good Youtube Channels with DMR content:
https://www.youtube.com/c/HamRadio20/search?query=DMR
https://www.youtube.com/c/HamRadioCrashCourse/search?query=DMR

North Texas DMR Repeaters:
https://dmrtexas.net/repeaters/ntx/