A **Very** Simple Introduction To DMR (Digital Mobile Radio) With EmComm Applications

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Quick Intro

- John Westerkamp / W8LRJ / Licensed in 2018
- Greene County / Beavercreek Resident Since 1986
- Bellbrook Amateur Radio Club Since 2018
- Assistant Emergency Coordinator for Events (GCARES)
- Electrical Engineer (B.E.E. from U.D., 1980, and Ph.D. from Purdue, 1985)
- Electrical Engineering Faculty U. of Dayton for 17 Years
- Networking, VPN, and Website Consultant

Quick Intro

- Roger Parrett / NQ8RP / Licensed in 2015
- Greene County / Bellbrook Resident
- Bellbrook Amateur Radio Club since 2015
- Electrical Engineer (UD / '79)
- Career in Hardware / Software development
  - Allen-Bradley, Philips, Reynolds & Reynolds, Hewlett-Packard, Scitex/Kodak
- Currently at Xerox as Financial Modeling Analyst

Quick Intro

- Jack Gerbs, WB8SCT

- Presented a program at BARC on DMR in November 2017

- Covered details of DMR radio and how to program

- Slides and YouTube video are available on the BARC website under *Programs*

Outline

- Some background on and initial exposure to DMR
- A brief technical review of DMR
- DMR in an EmComm environment
- Some special considerations when using DMR

Initial Exposure to DMR

- Tons of YouTube videos on (generically) what DMR is and how to program it.

- Most of it a re-hash of other people's opinions simply to (hopefully) generate paid click traffic.

- Tons of opinions that DMR is "the best" (over D-STAR and System Fusion) but not many reasons given WHY it's "the best".

Based on what I'd read,
I concluded:

- The DMR radios were either junk (cheap Chinese), or drastically out of my budget (Motorola). No thanks!

- Programming **required** a computer – Not simply to make it easier to set up (frequencies, options, etc), but to actually make it work. Ugh.

- People like the fact that they can talk state-wide / national with a DMR handheld. But you can do that with D-STAR…

I concluded - continued:

- DMR has been touted as great for EmComm (my original interest in it…) but analog VHF / UHF has worked fine for EmComm "forever", so why even bother with yet another mode? (or D-STAR / System Fusion, for that matter…). Not a big fan of "latest and greatest…"

… But … I ended up understanding …

- "**Talk Groups**" – A DMR radio will embed a user-designated Talk Group inside the _digitized_ "voice packet" prior to transmitting.

- DMR radios will automatically listen for the Talk Group you've set to use when you press PTT, _as well as any other Talk Groups you wish to monitor_ (**very loosely** analogous to scanning).

- For amateur use, Talk Groups are starting to be "standardized" and are generally a function of regional territory coverage as opposed to "interest".

… as well as …

- "**Receive Groups**" – In addition to <u>*automatically*</u> receiving the same Talk Group you transmit with, the radio can be programmed to receive (monitor) a number of other Talk Groups as well.

- RX Groups are optional, but are a good way to establish a hierarchy of radio communications when you are considering a "top down" approach to radio communications service for, say, an EmComm strategy.

… as well as …

- "**Time Slots**" – If set up properly, two radios can be utilizing the repeater _at the same time_ via TDM.

- For instance, Time Slot 1 can be reserved for personnel responsible for Safety / Medical related communications, and Time Slot 2 can be reserved for the more mundane (and often more busy) resource and allocation related traffic.
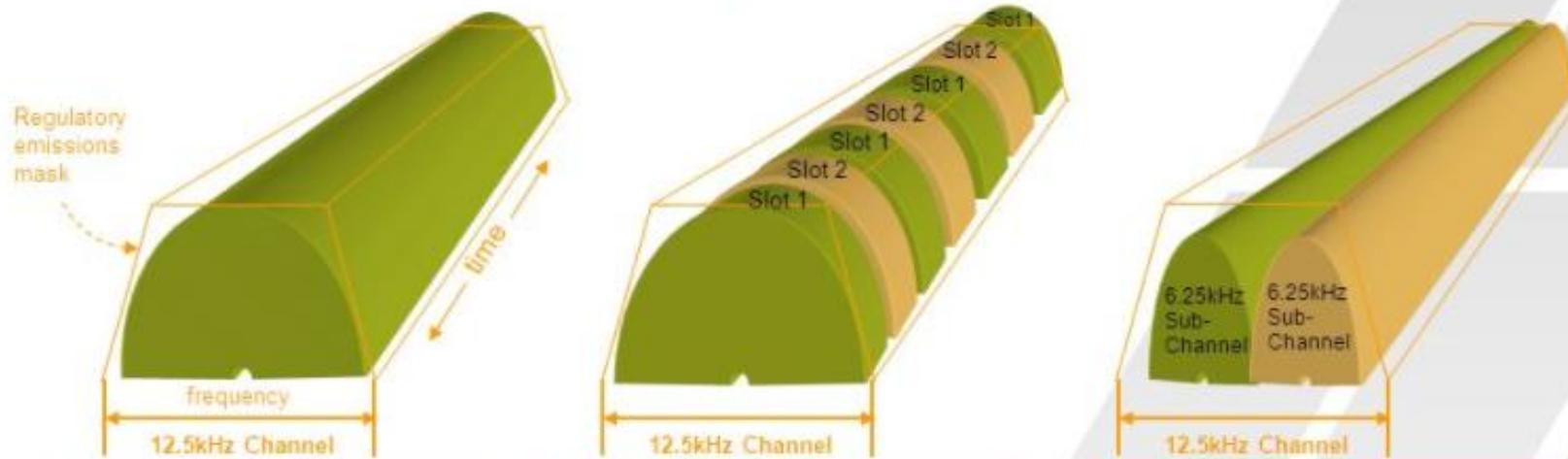
DMR – How did we get here?

- FCC Mandate
  - By January 1, 2013, all public safety and industrial land mobile radio systems must operate within 12.5 KHz, or **_equivalent-efficiency_**.
  - Equivalent-efficiency is further defined as:
    - One voice path in a 12.5 KHz channel
    - Two voice paths in a 25 KHz channel
    - Data Operations on channels greater 12.5 KHz must employ data rates greater than 4.8 kbps per 6.25 KHz channel,
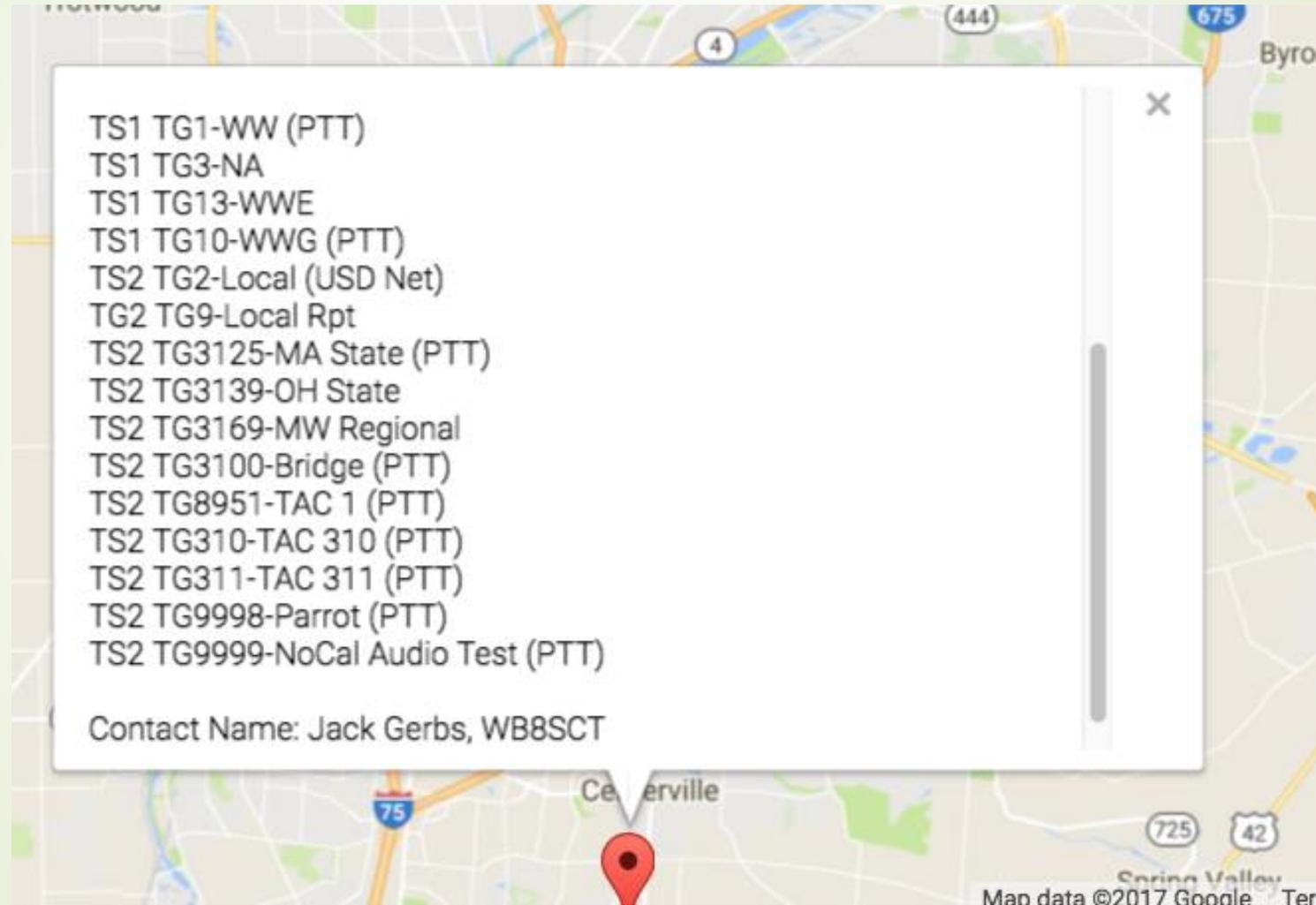 - **FCC's Ultimate re-banding goal is 6.25 KHz**

Analog FM vs. DMR

Analog FM

- Repeater Transmit and Receive Frequencies
- CTCSS Tones (Frequencies)
- Analog FM

- Local Coverage (Echolink & IRLP)
- Multiple Users Share Frequency

- One User At Any Time
- Any Licensed Amateur May Use

DMR Equivalent

- Repeater Transmit and Receive Frequencies
- Color Code (Numbers 1-7)
- Digital Time-Division Multiple Access (TDMA)
- World-Wide Coverage (via Internet)
- Multiple Users Share Frequency But Use **Talkgroups/Timeslots** To Separate
- Two Users Can Share The Bandwidth
- Additionally Requires a DMR ID
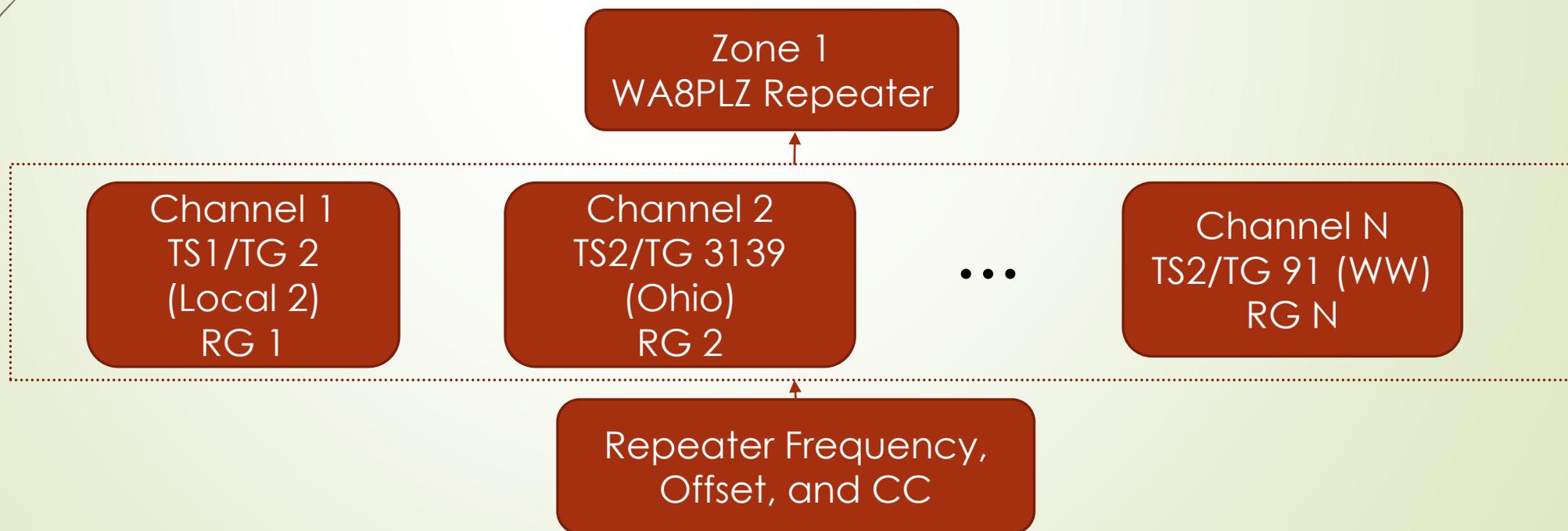- Note that DMR radios generally also work with analog repeaters

Timeslots (TS) and Talkgroups (TG)

TS1 TG1-WW (PTT)
TS1 TG3-NA
TS1 TG13-WWE
TS1 TG10-WWG (PTT)
TS2 TG2-Local (USD Net)
TG2 TG9-Local Rpt
TS2 TG3125-MA State (PTT)
TS2 TG3139-OH State
TS2 TG3169-MW Regional
TS2 TG3100-Bridge (PTT)
TS2 TG8951-TAC 1 (PTT)
TS2 TG310-TAC 310 (PTT)
TS2 TG311-TAC 311 (PTT)
TS2 TG9998-Parrot (PTT)
TS2 TG9999-NoCal Audio Test (PTT)

Contact Name: Jack Gerbs, WB8SCT

DMR Hierarchy

- Add Talkgroups and Digital Contacts (Import Worldwide Database)
- Add Receive Groups (RG) (Collection of Talkgroups)
- Repeater Frequency, Offset, and Color Code (CC)
- Program Channels (One for each Timeslot/ Talkgroup on a Repeater)
- Zone (A collection of Channels on a Repeater; typically one per repeater)

Zone 1
WA8PLZ Repeater

Channel 1
TS1/TG 2
(Local 2)
RG 1

Channel 2
TS2/TG 3139
(Ohio)
RG 2

. . .

Channel N
TS2/TG 91 (WW)
RG N
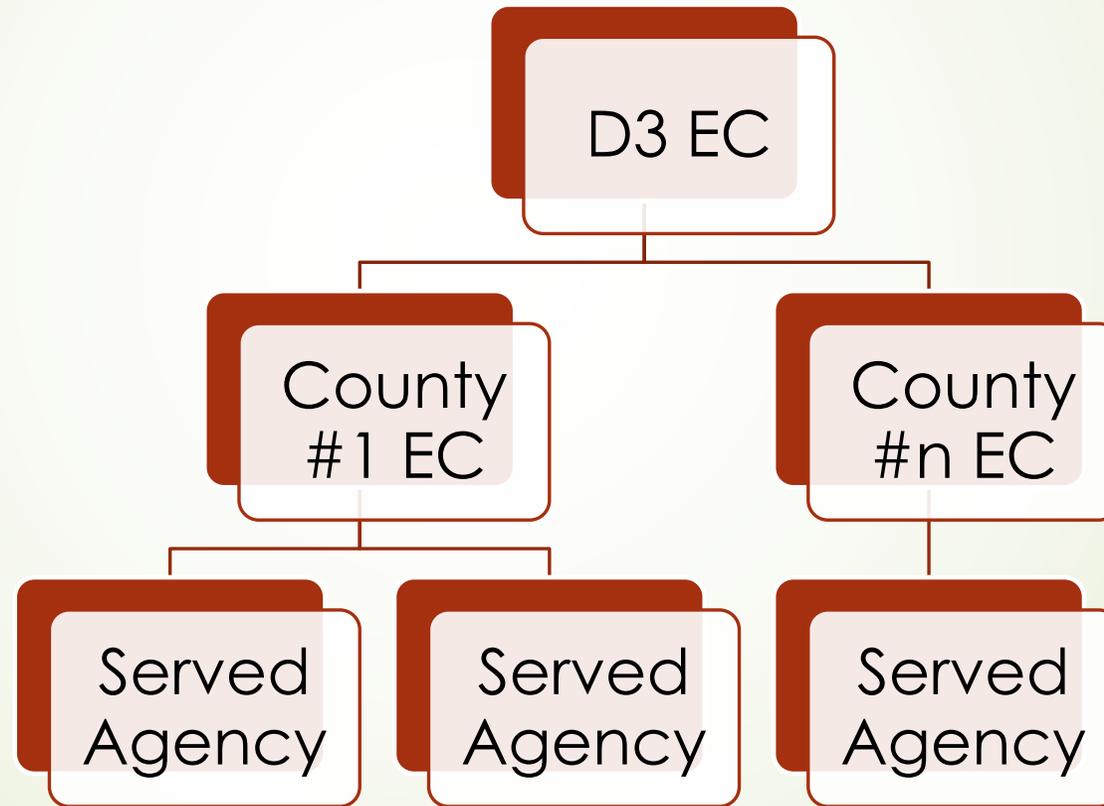
Repeater Frequency,
Offset, and CC

What About EmComm?

- In a typical analog repeater environment, everyone hears everyone
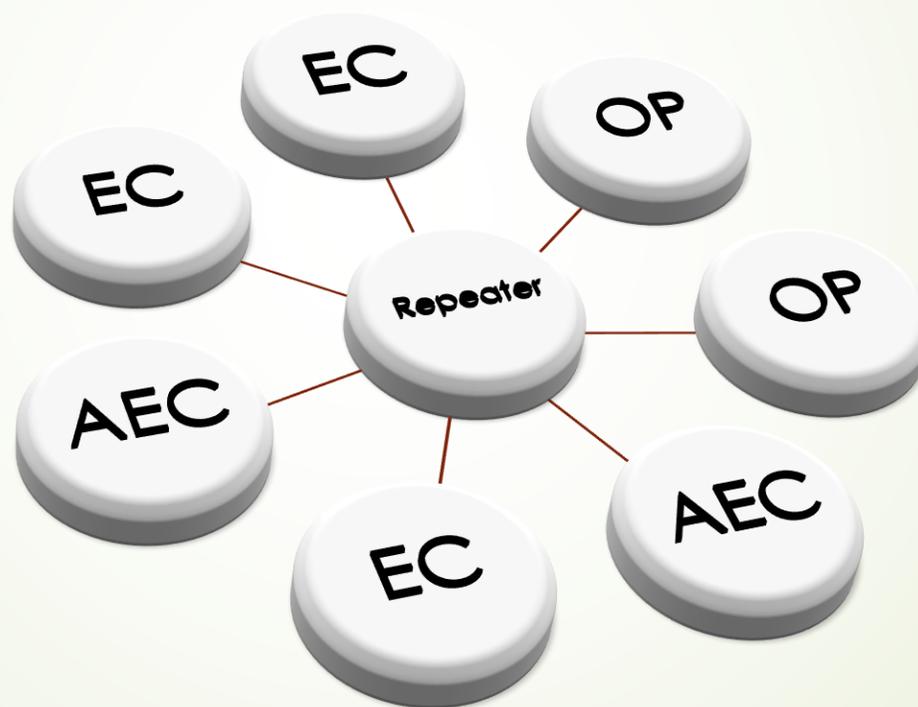
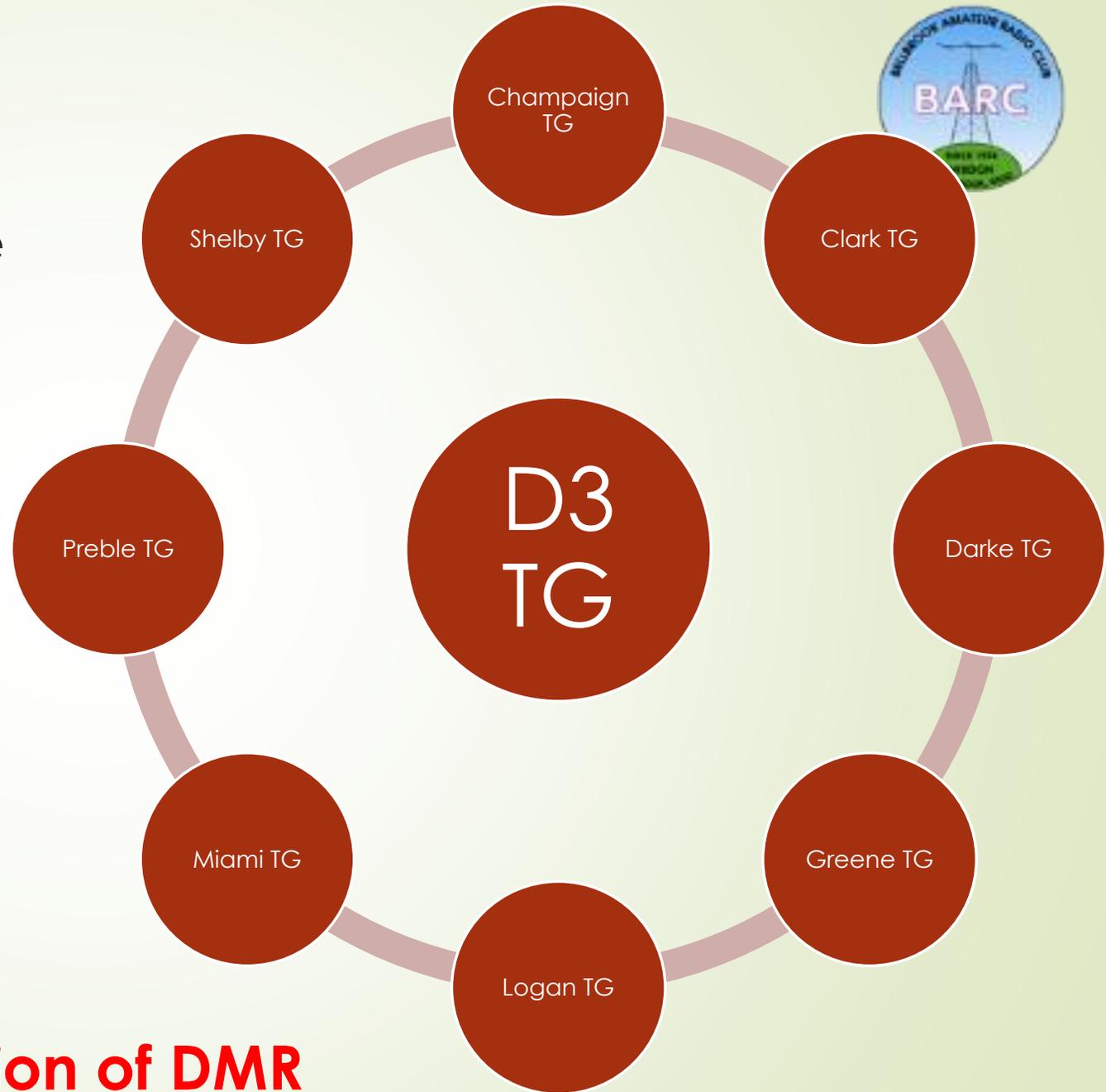# DMR can be deployed in a hierarchical manner
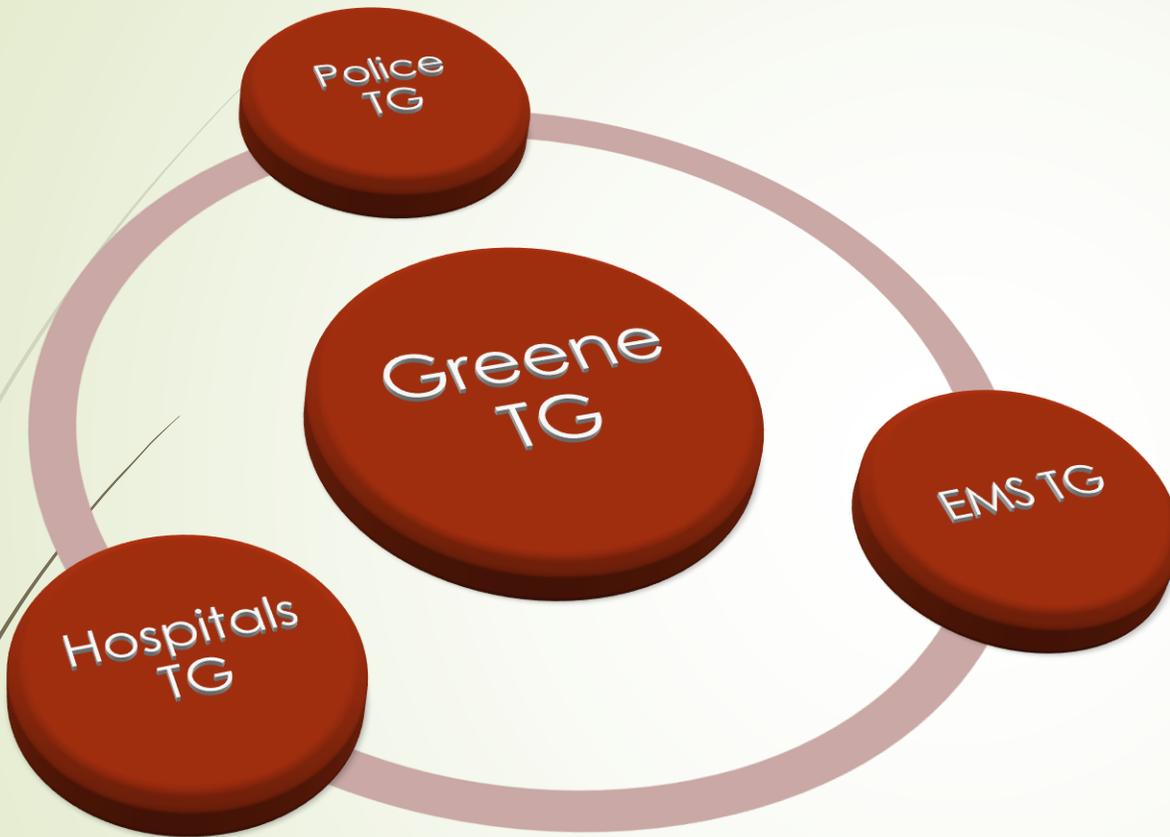

A sample implementation of DMR

Used creatively, DMR could be used to enhance critical communications

In this implementation, the _District_ EC communicates simultaneously with the subordinate _County_ ECs. No one else would hear the communications.
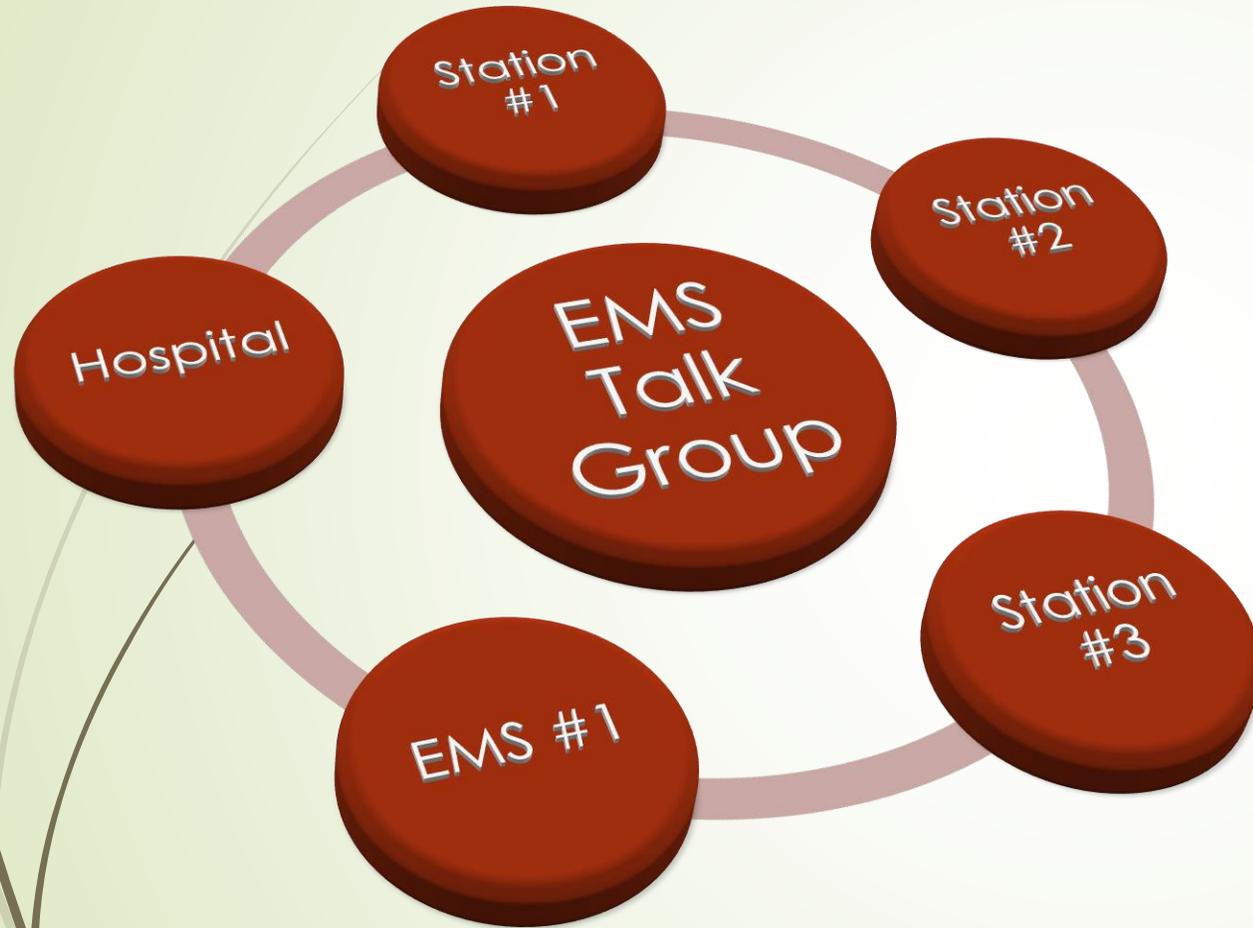
A sample implementation of DMR

The *County* (i.e. Greene) EC would communicate directly with local county operators at various served agencies, without hearing other county traffic (i.e. Preble, Mont, etc).

However, the Greene County EC could monitor communications from their supervising EC and perhaps other (peer level) County ECs as well.

A sample implementation of DMR

The Greene County EMS Talk Group would communicate directly with operators at fire stations, hospitals, EMS units, etc., without hearing local non-EMS traffic.

A sample implementation of DMR

EmComm DMR Considerations

- Each county would most likely require its own DMR repeater.

- Each DMR repeater would need to be linked together either via the internet **or (more preferably) via a private mesh network**.

- Time Slot and Talk Group numbering systems would need to be agreed upon to support connectivity.

- Everyone participating in this mode would need to acquire their own DMR radio, have it programmed by the admin, and then "not mess with it".

A sample implementation of DMR

DMR Considerations - continued

- You need to apply for a DMR ID – It's free and painless to apply for online, and you'll get it in less than 48 hours. The DMR ID you get will be programmed into your radio, and will show up on anyone else's radio who happens to be listening to the Talk Group you are transmitting on.

- A DMR ID can be used to initiate "private" communications (your DMR ID is like a Talk Group), as is how you send Text Messages to a specific operator.

DMR Considerations - continued

- You need to keep the conversation short. Typically a DMR radio has a (typically) green light to show that the frequency (not just the Talk Group) is in use, even if you can't hear them due to your radio not being programming to pick up that Talk Group.

- You can actually send Text Messages with DMR, though the delivery is not assured. You would need to devise your own (manual) protocol for critical messaging.

- Programming a radio is not difficult. But the instructions leave much to be desired. The "State-wide" code plugs for Ohio are overly bloated.

DMR Considerations - continued

- Pick your Talk Group responsibly. No need to select "North America" to chat with your friend across town.

- Announce your Talk Group often. Some people may be monitoring several Talk Groups and may wish to join in the conversation – so they will need to know which TG to set their radio to when they press the PTT.

- Wait for the green light to go off or you may disconnect somebody on another Talk Group.

- Wait for 2 seconds after hitting PTT to allow distant repeaters to come up.

DMR Considerations - continued

- DMR is fun to tinker with – if you're into that sort of thing. It took me 10 revisions to get my radio to operate the way I wanted it to. Except now I'm on Rev 16.

- Unless you belong to a group that has formed their own DMR net or Talk Group, or belong to (or stumbled into) a group who has adopted DMR as one of their primary (and _active_) communications modes, do not expect to be "doing ham radio" with it. Your QSO's (if any) will be few and far between.

DMR Considerations - continued

- Some of the radios can now be programmed via the front panel, though it can be quite cumbersome.

- DMR is really meant to be used in a coordinated fashion, in a structured environment, with a known set of operational rules, and an established set of Talk Groups.

- Trying to "do ham radio" with a DMR radio drastically misses the point about how DMR was intended to be used, and quite frankly, I would not recommend it.