

Digital **M**obile **R**adio

An overview of the basic for DMR

Agenda

- Overview
 - What is DMR
 - How does DMR work
- Getting Started
- Key information
- Programming a radio
- Summary

Overview

What is it and how does it work

What is DMR

- DMR, Digital Mobile Radio, is a digital radio standard specified for business mobile radio users developed by European Telecommunications Standards Institute (ETSI) in 2005
- The standard is designed to operate within the existing 12.5kHz channel spacing used in licensed land mobile frequency bands globally
- DMR was originally developed for commercial use. It was never designed for Amateur use.

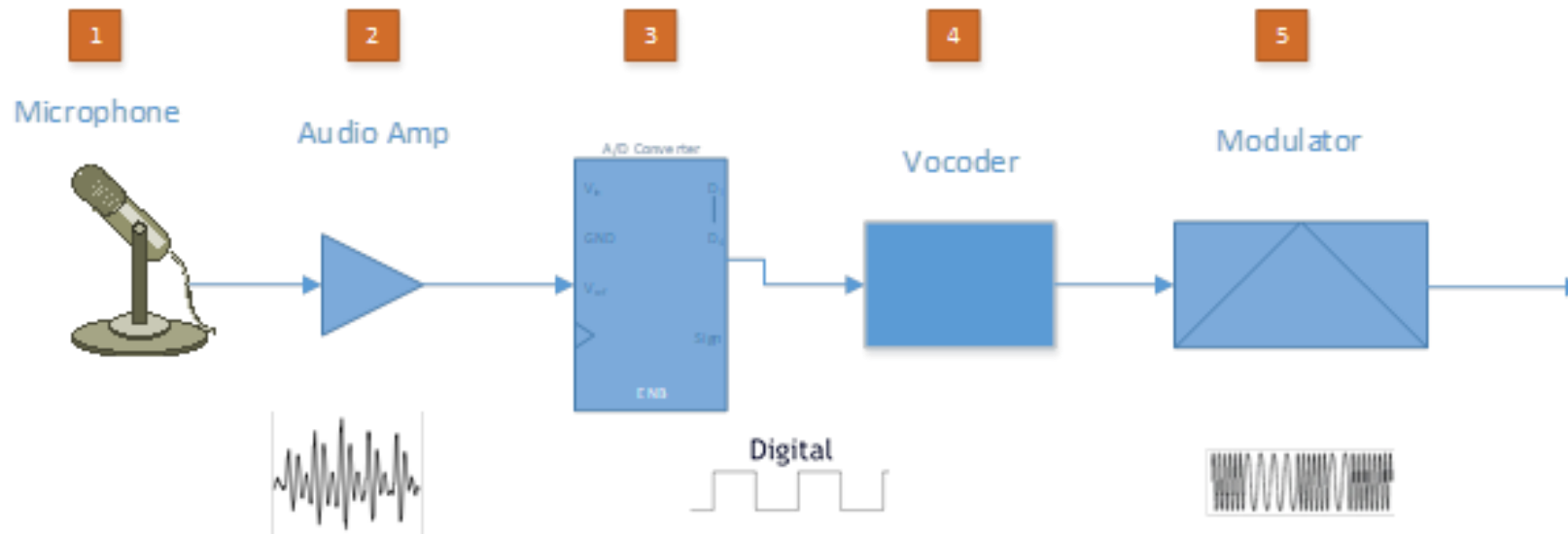
Three Tiers of DMR

- **Tier 1 (*Unlicensed*)**
 - Products are unlicensed and have limited power (0.5-Watt RF power or lower) and Limited to 16 channels in the 446MHz band.
 - Limited to personal and recreational, no repeater systems.
- **Tier 2 (*Licensed Conventional*)** Most used by Ham Operators
 - Radio equipment can operate anywhere within the DMR frequency range from 66 to 960MHz and use two-slot TDMA in 12.5kHz channels.
 - This tier's more powerful radios and repeater system capabilities give you the advantages of wide-area coverage and the advanced capabilities of DMR radios.
- **Tier 3 (*Licensed Trunked*)**
 - Uses trunking technology, which dynamically allocates channels and resources to users on an as-needed basis.
 - Designed for large-scale operations and demanding professional environments that uses a wide area communications network with advanced features. Used in public safety and industries including Electricity, Oil & Gas, Transportation, etc.

How DMR Works

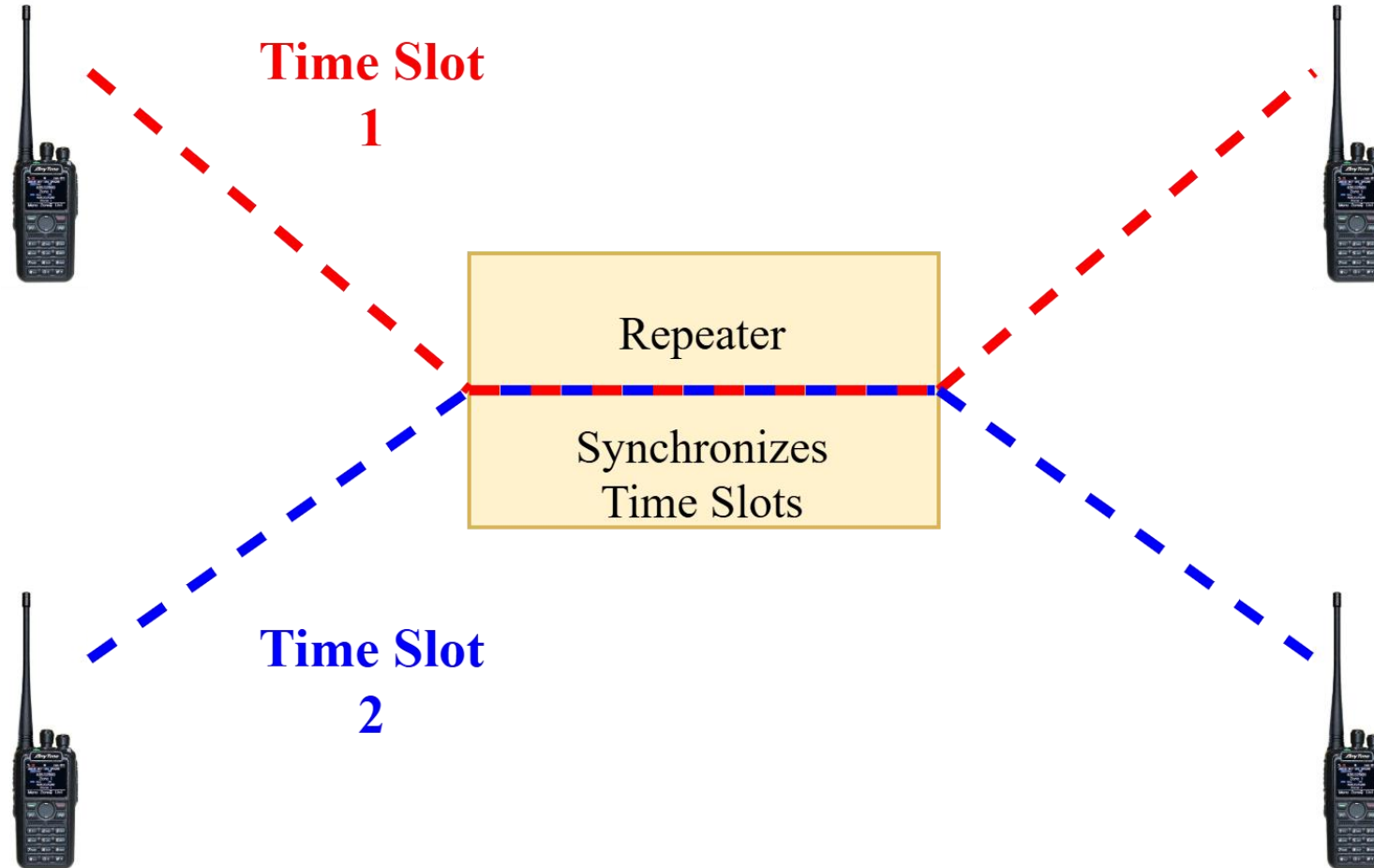
- Here's a breakdown of how DMR works:
 - **Voice Signal Conversion:** DMR converts voice into digital packets using the AMBE+2 vocoder. When it receives it reverses the process from digital to analog voice.
 - **Transmission:** Data packet information is transmitted using 4-FSK and TDMA technology.
 - DMR uses Time Division Multiple Access (TDMA) technology, which divides a 12.5 kHz channel into two time slots.
 - This allows two separate conversations to occur simultaneously on the same frequency, doubling the channel's capacity.
 - **Error Correction:** DMR incorporates error correction to improve the quality of the transmission and minimize data loss.

Analog to Digital Conversion



1. Analog audio input through microphone
2. Audio amplifier boost signal
3. The Audio to Digital (A/D) converter changes audio signal to digital
4. The Vocoder compresses the digital signal. It may also add forward error correction
5. Compressed digital signal is modulated onto the carrier wave.

TDMA Time Slots

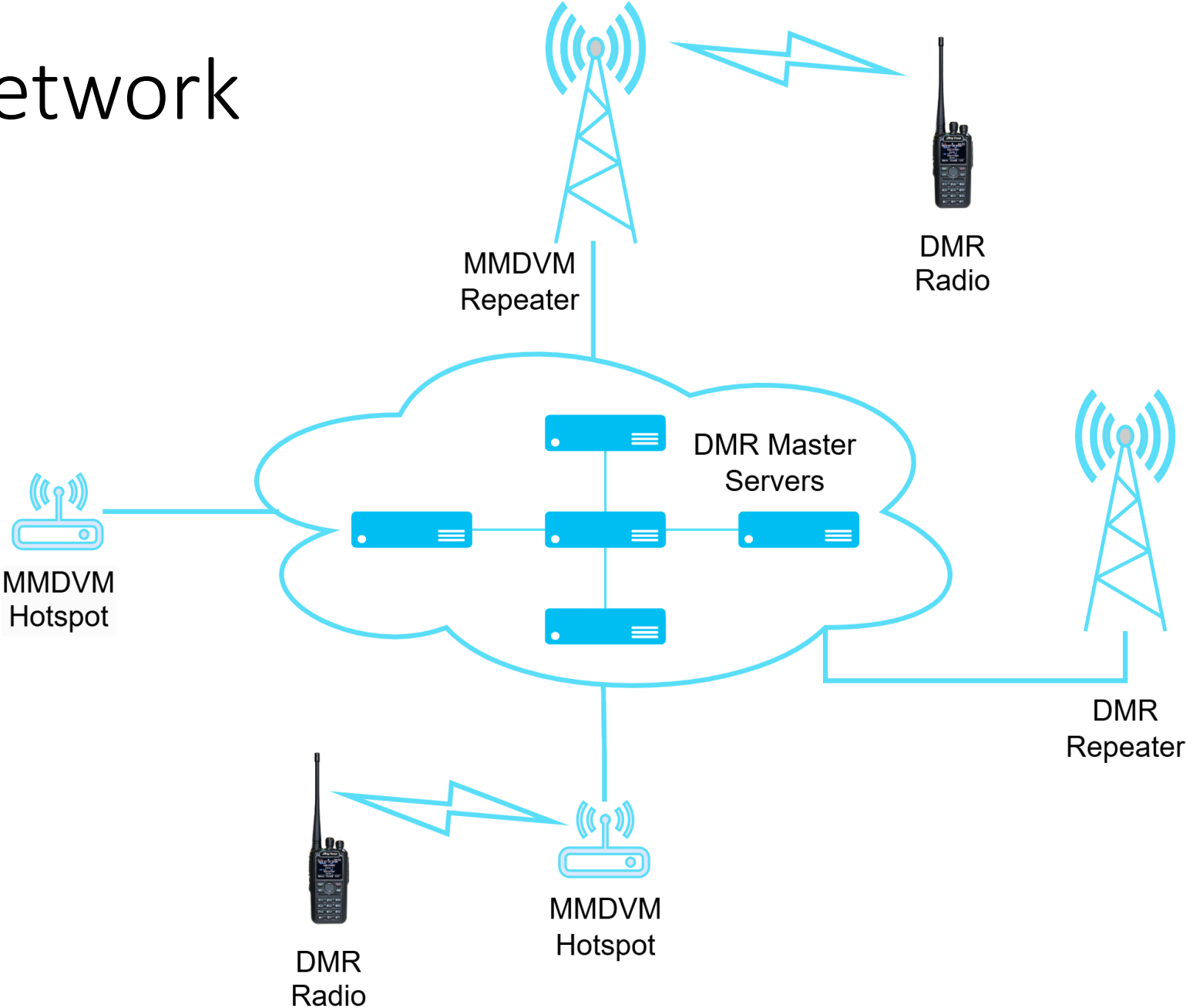


Two conversations can be hosted on the same repeater using DMR

DMR Network

- DMR networks consist of repeaters and gateways connected to internet that allow users to communicate over a wider area, creating a network of interconnected users.
- The system uses internet-connected repeaters and hotspots to enable worldwide communication among hams.
- Networks like BrandMeister and DMR-MARC are popular global DMR networks in the amateur radio community.

DMR Network



Getting Started

Digital Identification

DMR Identification Number

- DMR uses numerical IDs for each radio on a particular network.
- A DMR ID is a unique number assigned to you (and your callsign) by the Radioid.net Team.
- Like a telephone number or IP address, your DMR ID identifies you as a unique radio user on the various DMR networks and repeaters around the world.
- Identifying every radio and repeater uniquely with an ID enables the very essence of DMR networking to function. i.e making private calls to each other, organizing specific talk groups for countries, states, regions, cities, clubs, special interest groups etc.
- A DMR ID enables you to talk to and hear only the people and traffic that you want to hear.

Apply for DMR ID

1. You need the Official Copy of your Amateur License obtained from the FCC
2. Go to <https://radioid.net/> and apply for a DMR ID
3. Once you get there, click on "Log In/Sign Up" at the left-hand side of the screen towards the bottom of the black options bar.
 - From here you can create an account and work through all of the prompts.
 - You will get to a point where it will ask you to upload an official copy of your FCC license.
4. Upload the copy we obtained from the FCC.
5. Now Wait. It may take up to 2 days for your account to be verified.

Key Information

Putting together all the puzzle pieces

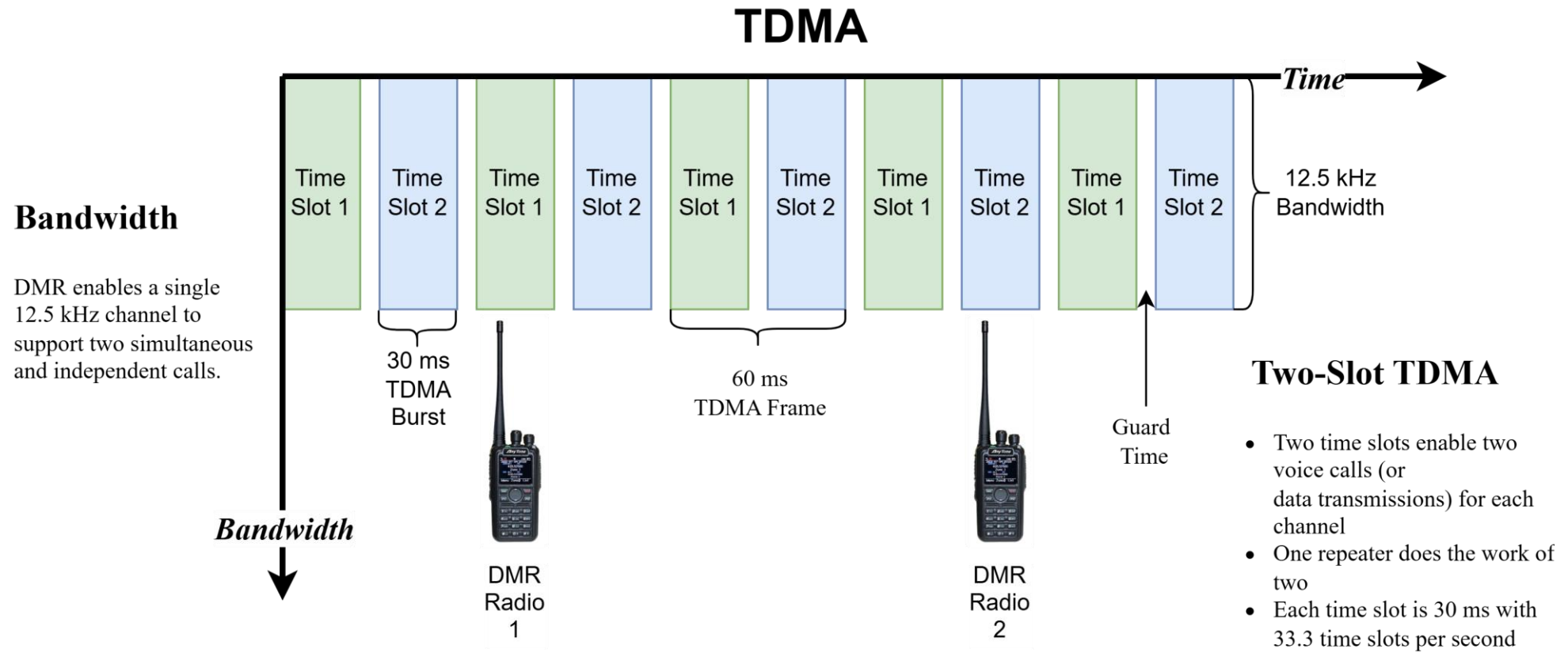
Terminology

- In order to use DMR there are more puzzle pieces beyond Frequencies and Repeaters.
- Remember that DMR was created for commercial use and some of the terminology is different from Amateur Radio:
 - Time Slots
 - Color Codes
 - Talk Groups
 - Receive Groups (Rx Group)
 - Code Plug
 - Channels
 - Zones

Time Slots

- As stated earlier, DMR uses Time Division Multiple Access (TDMA) technology, which divides a 12.5 kHz channel into two time slices or slots.
- DMR sends and receives data in 30 millisecond time slices called Time Slots.
- Each channel can carry either voice and/or data depending on system design.
- The two time slots are called Time Slot 1 (TS1) and Time Slot 2 (TS2).
- One DMR repeater does the work of two analog repeaters.

TDMA



Color Codes

- There are 16 different CCs (CC0-CC15).
- DMR repeaters use Color Codes (CC) much like analog repeaters use CTCSS (PL) or DCS.
- To access a repeater you must program your radio to use the same CC as the repeater.
- The use of CC is not optional on DMR systems.
 - This code is crucial for preventing interference between multiple repeaters operating on the same frequency.
 - Each repeater is assigned a unique CC to ensure seamless and interference-free communication within its network.
- If the CC is not set correctly, you will not be able to access the repeater.

Talk Groups

- A Talk Group (TG) enables one-to-many communications, can be equated to a conference call or a chat room.
 - DSTAR uses reflectors
 - YSF used wires room
- Anything transmitted to a TG is transmitted to anyone listening to that TG.
- TG are equivalent to Work Groups in the Commercial radio world.
- Provide a way of separating or filtering communications when there are multiple user groups with different interests.

Talk Group Types

- Static TG (Fulltime or FT)
 - A static TG is one that is permanently activated on a particular timeslot by the repeater sysop.
 - A static assignment passes ALL traffic from the DMR network over the air on the timeslot it is assigned.
- Dynamic TG (Push to Talk or PTT)
 - On Demand TG assignments are used for temporary activation on a timeslot on a particular repeater.
 - This type of TG functions for a set amount of time *after* a local repeater user activates it by transmitting on a repeater using that TG in their radio.

Talk Groups

Timeslot 1			Timeslot 2		
TG Name	Hold	TG ID	TG Name	Hold	TG ID
Penn State	FT	3142	Local Repeater	FT	9
Penn TAC	15	31421	Local Area	FT	2
Mid Atlantic	FT	3173	Western PA	15	31422
Nationwide	5	3100	PEMA	5	31420
FT=Full Time	5/15= PTT activation time				

Example of a configuration for a repeater.

As illustrated, a TG can be either static or dynamic when programmed into a repeater.

Receive Groups

- A list for a channel that is imbedded in the programming for the channel so when ever you listen to that channel you also hear the talk groups in the receive group list.
- Receive group lists were made for commercial users so that a group of users could be paged while they were on their own talk groups.
- In ham radio it is typically used so when you are on a time slot you hear everyone else on that time slot so you do not break up QSO's of other users on different talk groups in the same time slot or hear repeater or hotspot announcements.

Contacts

- There are two types of contacts when programming a DMR Radio.
 - Contact List
 - Contact/TG List
- This is a little confusing depending on the software used to create code plug.
- A contact is essentially a single entry that represents a specific DMR ID associated with a user.
- Each contact has a unique ID, and this ID is used to route the communication to the correct recipient and provides contact information on your radio.
- You can download the latest list of DMR ID from [Download DMR IDs – Anytone.org](#) and upload to your radio.

Contact/TG

- When creating channels you will need to create a list of contacts to select, usually TG.
 - Name
 - TG/DMR ID
 - Call Type
- There are three call types in DMR: Group Call, Private Call, and All-Call.
 - Group Call - A call from one radio to a group of radios.
 - Private Call - A call from one radio to another radio using the other radio ID.
 - All Call - A carryover from commercial and is programmed into supervisor radios allowing the ability to make a call to all radios on the same time slot regardless of talk group. All-call is not used in ham radio.

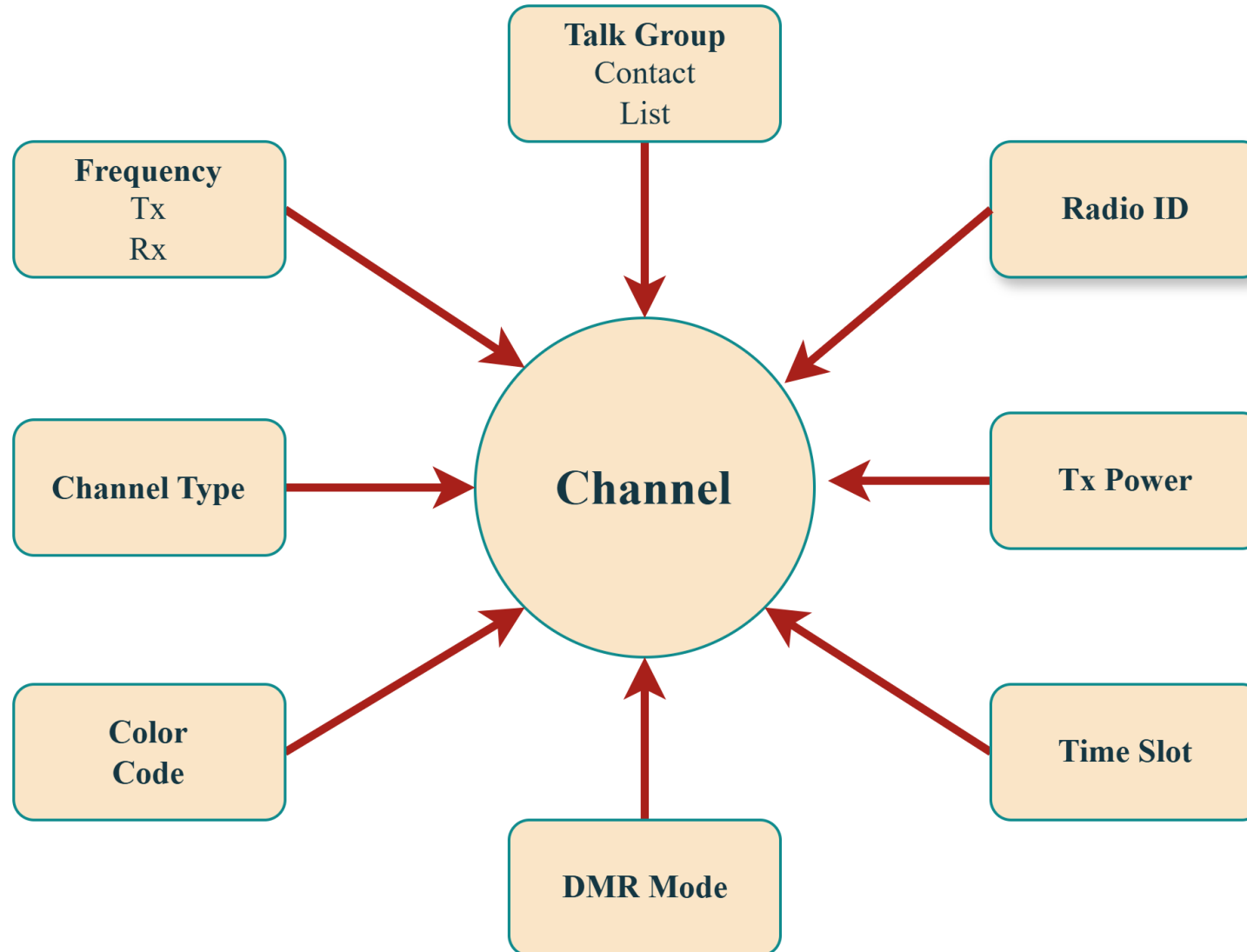
Example Contact/TG List

No.	TG/DMR ID	Call Alert	Name	Call Type
1	9	None	OpenSpot	Group Call
2	93	None	North America	Group Call
3	3142	None	PA State Wide	Group Call
4	6	None	XLX Use	Group Call
5	4000	None	Disconnect	Private Call
6	9990	None	Parrot	Private Call
7	98	None	Radio Test	Group Call
8	31420	None	PEMA/ACS ARES	Group Call
9	31421	None	PA TAC	Group Call
10	4001	None	XLX Mod A	Private Call
11	4002	None	XLX Mod B	Private Call
12	4003	None	XLX Mod C	Private Call
13	4004	None	XLX Mod D	Private Call
14	3100	None	USA	Group Call
15	310	None	TAC 310	Group Call
16	311	None	TAC 311	Group Call
17	312	None	TAC 312	Group Call
18	313	None	TAC 313	Group Call
19	31422	None	Western PA	Group Call
20	31425	None	PennLink Cross	Group Call
21	913	None	English	Group Call
22	9999	None	OpenSpot Parrot	Private Call
23	68814	None	XLX814	Private Call
24	3166513	None	K3SMT Repeaters	Group Call
25	2	None	WorldWide	Group Call
26	91	None	WorldWide Eng	Group Call

Channels

- A DMR channel contains specific information on how a call is made.
- Think of it as detailed instructions on how to make a phone call.
- Remember that this was designed to be a commercial radio.
 - Since each commercial DMR system is specific to the customer the radio needs to be programmed to work on that particular system.
 - Amateur Radio DMR networks are also different.
- Example of channel information
 - Channel Name – OpenSpot
 - Radio ID – DMR ID number
 - Channel Type – Digital
 - Tx and Rx frequency – 434.500
 - Color Code – 1
 - Time Slot – TS 1
 - TX Power – Low
 - Band Width – 12.5K
 - DMR Mode – Repeater
 - Radio ID – KR3L
 - Contact – PA Statewide
 - Rx Group - OpenSpot

Channel Input



Example of Channel configuration

Channel Information Edit---22

Channel Name: USA - Mt Davis

Receive Frequency: 443.72500
Transmit Frequency: 448.72500
Correct Frequency[Hz]: 0

Channel Type: D-Digital
Transmit Power: High
Band Width: 12.5K
TX Permit: Always
Scan List: None

Exclude channel from roaming: off
DMR MODE: Repeater
Analog APRS Report Freq: 1

PTT Prohibit Talk Around(Simplex) APRS RX
 Work Alone DataACK Disable Auto Scan

Digital

Contact: USA
Radio ID: KR3L
Color Code: 1
Slot: Slot2
Receive Group List: None
Digit Encryption: Off
Extend Encryption: AES
ARC4 Encryption: Off
AES Digital Encryption: Off
Multiple Key: Off
Random Key: Off
SMS Forbid: Off

Send Talker Alias Call Confirmation Ranging
 Slot Suit SMS Confirmation Idle TX

Zones

- A zone is a group of channels and can be thought of as a phone book.
- Zones can be created as a logical group of channels for the user:
 - Zone based on location
 - Zones based on repeaters/hotspots
 - Zones based on DMR type (repeater or simplex)
 - Zones based on Channel type (digital or analog)
- There are many ways to arrange zones
- Depending on the radio, the number of channels for each zone may be limited.

Example of Zone list

Name	Zone Channels	A Channel	B Channel
OpenSpot DMR	14	USA	PA State Wide
OpenSpot	9	Parrot	North America
Somerset Analog	9	K3SMT UHF	K3SMT VHF
Mt Davis DMR	10	USA - Mt Davis	WPA - Mt Davis
Hays Mill DMR	7	PA State - HM	PEMA - HM
Statler Hill DMR	7	PA Statewide SH	PEMA - Statler
Seven Spring	6	Local TS 2 - 7 S	PA State - 7 S
KR3L HotSpot	10	USA HotSpot	PA State HS

Programming a Radio

Putting it all together

Code Plug

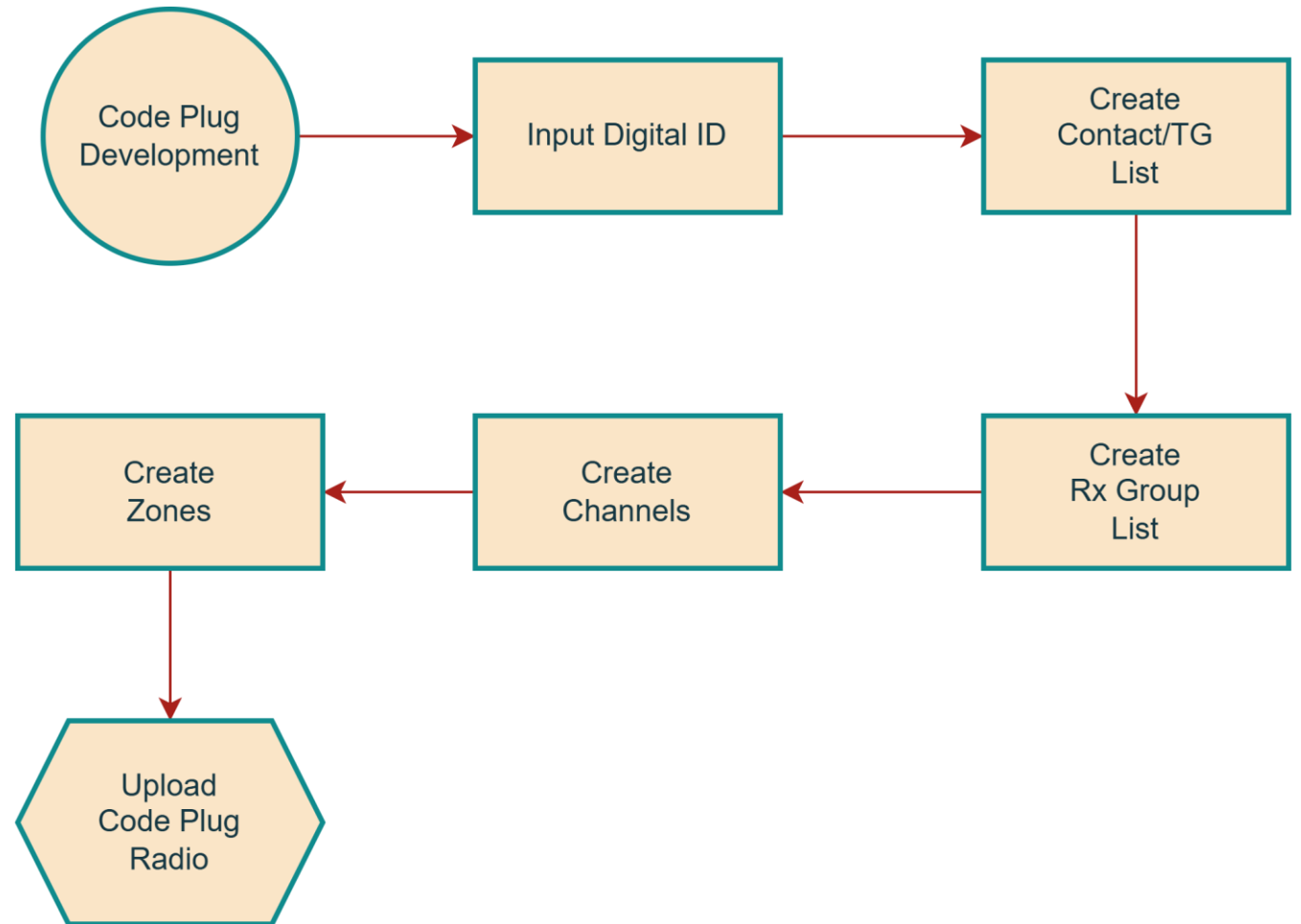
- A code plug is simply a radio's configuration file.
- It contains all the necessary settings, such as frequencies, TG, CC, TS, contacts, and other parameters, to ensure your radio operates correctly within a specific network or system.
- Using programming software, you configure the channels and operating parameters of a radio.
- This file is uploaded to the radio and typically should also be saved on your computer as a backup.
- You can also download the code plug from a radio to modify it.

Customer Programming Software (CPS)

- This is the software used to create a code plug for DMR radio.
- The software name varies by manufacturer and so does the programming screens and windows:
 - CPS
 - Customer Programming Software
 - Computer Programming Software
 - CodePlug Programming Software
 - CPE (Code Plug Editor)
- RT Systems also has software for programming DMR radio, along with other third party software developers.

Code Plug Creation

- Creating a code plug is a multi-step process.
- Before you can create channels, other lists will need to be created.
- Following development process will reduce the amount of hopping around to create the code plug.



Summary

Conclusion

- This is the basics over for programming a DMR radio.
- There are many additional features that can be configured.
- Digital mobile radio is a digital radio standard for voice and data transmission in non-public radio networks.
- Remember that DMR was developed for commercial use and Ham are trying to adapt it to their use.
- The purpose of this presentation was to help you feel a bit more comfortable with some of the basics and terminology used in the DMR world.
- Now that you have the basics you can create your own code plugs.

Useful Websites

- DMR Control Center
 - [DMR-SE](#)
- BrandMeister
 - [Dashboard | BrandMeister](#)
- Listen to BrandMeister Network
 - [Hoseline](#)
- Radioid Net – DMR ID search and Contact List updates
 - <https://radioid.net/>