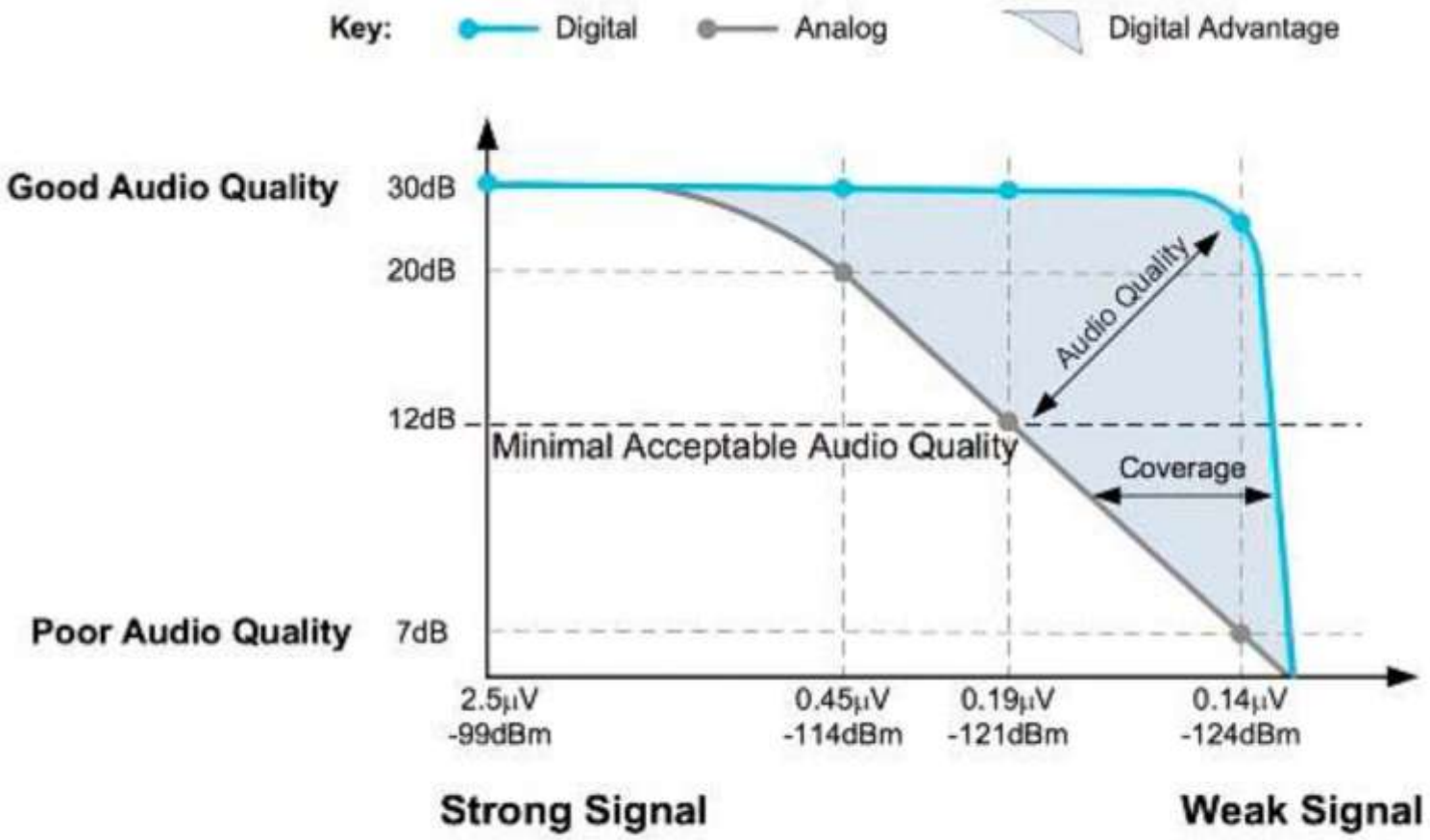
DMR
by
Bob Hoffmann
K4CQO

What is DMR?

- DMR (Digital Mobile Radio) is:
- Changes voice / tones into a digital stream
  - Digital signals carry voice without static, or noise
  - Digital signals have a longer distance for reception
- Used for communication to repeaters or unit to unit
- Uses VHF and UHF frequencies

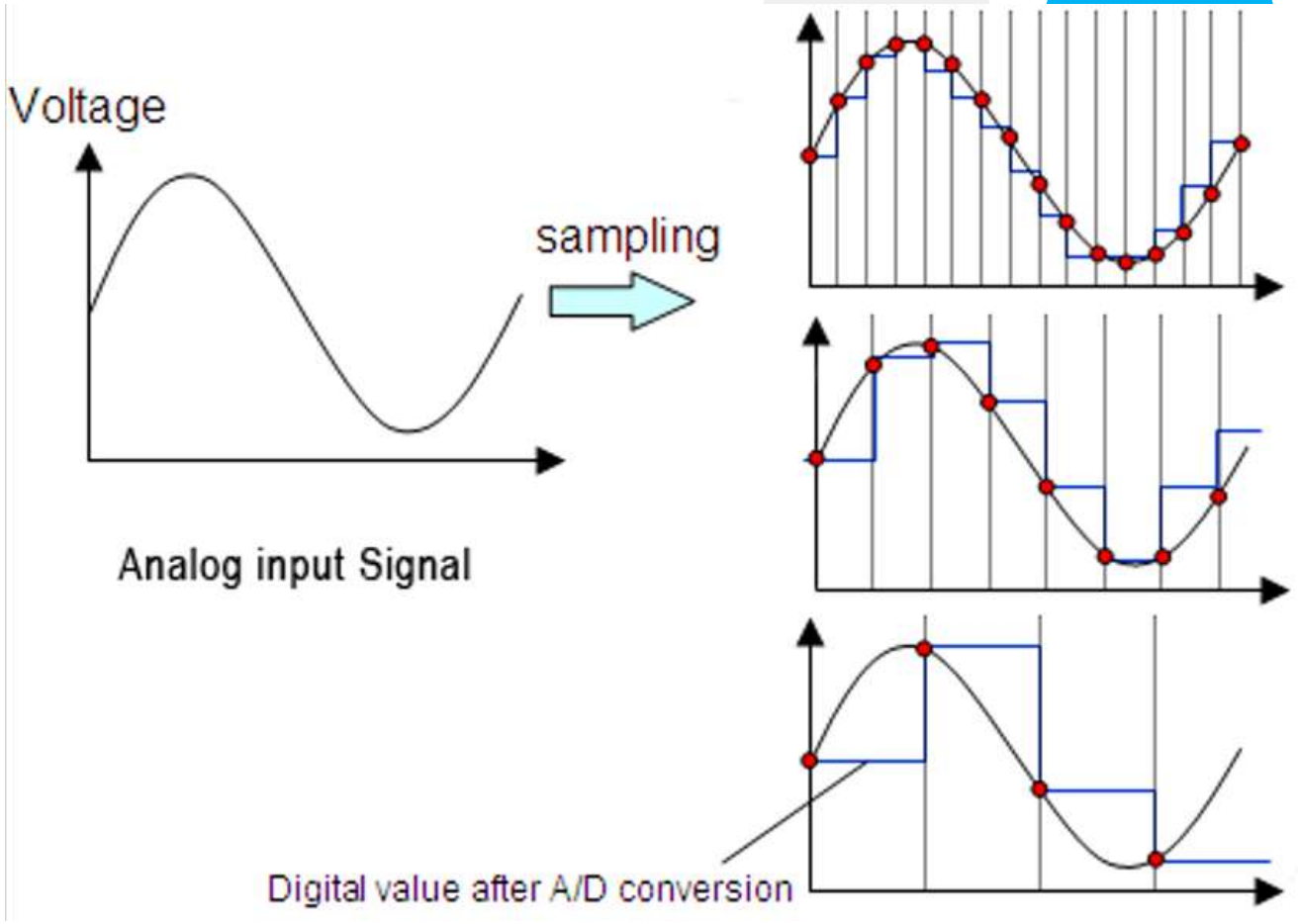
What is DMR? (cont.)



DMR / analog weak signal performance
(courtesy Tait Communications)

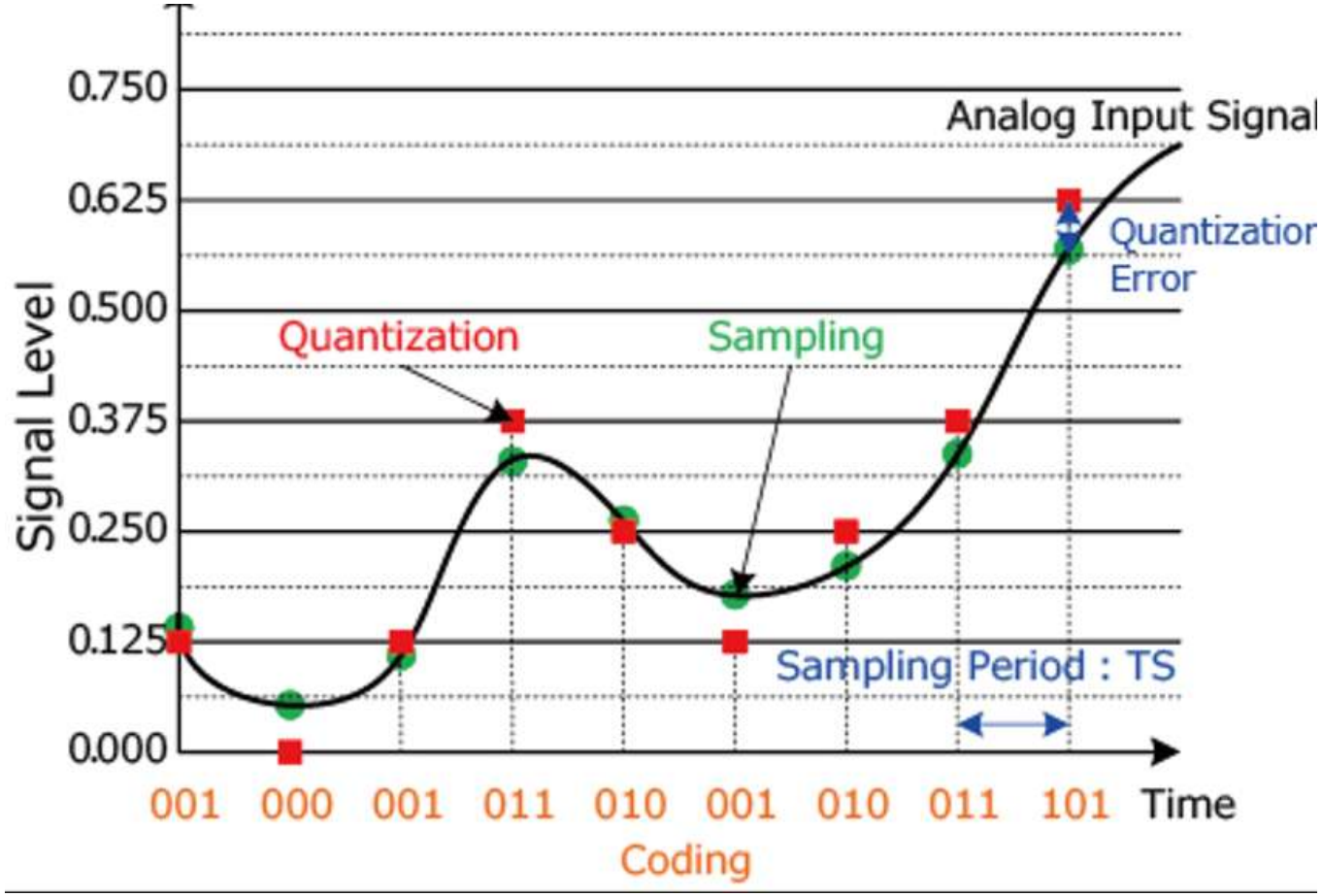
DMR Processing

- How does DMR get your voice into a digital signal?
- **Sampling:**



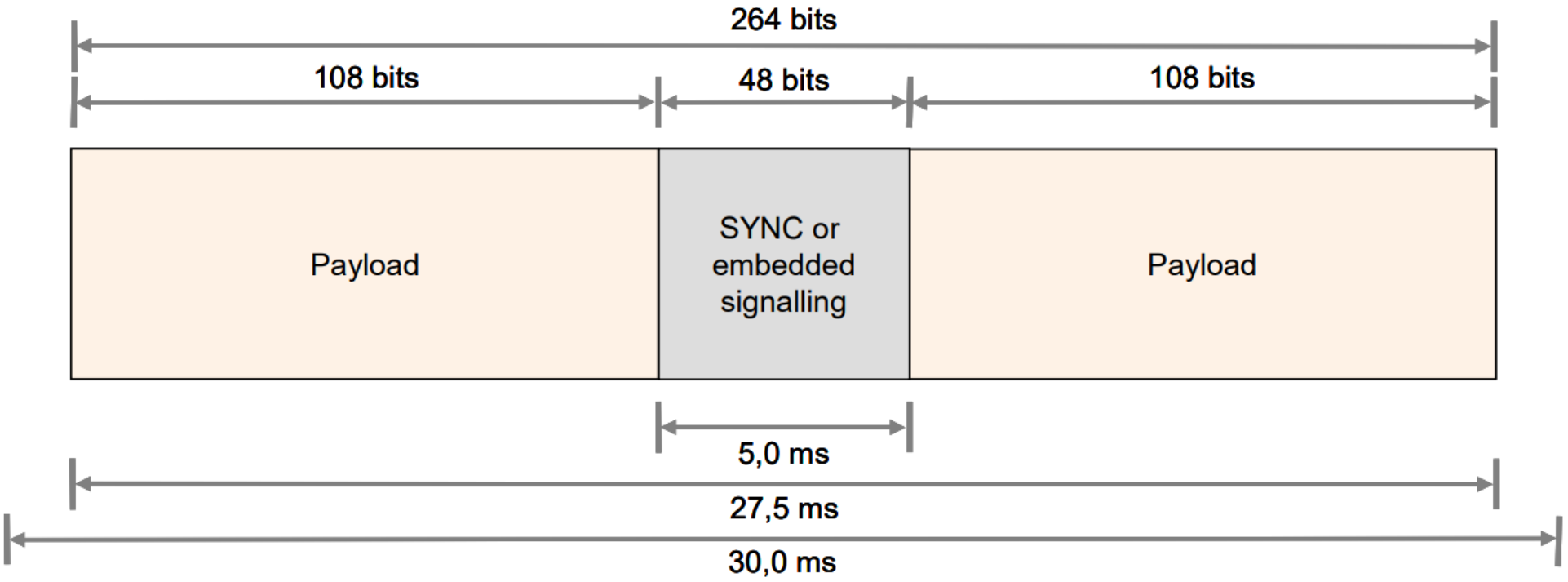
DMR Processing (cont.)

- DMR uses a vocoder (DVSI's AMBE+2™)
- same as used for Fusion & D-Star
- provides an 8 Khz sample rate, noise cancelation, and compression of 30 ms speech to 216 bits



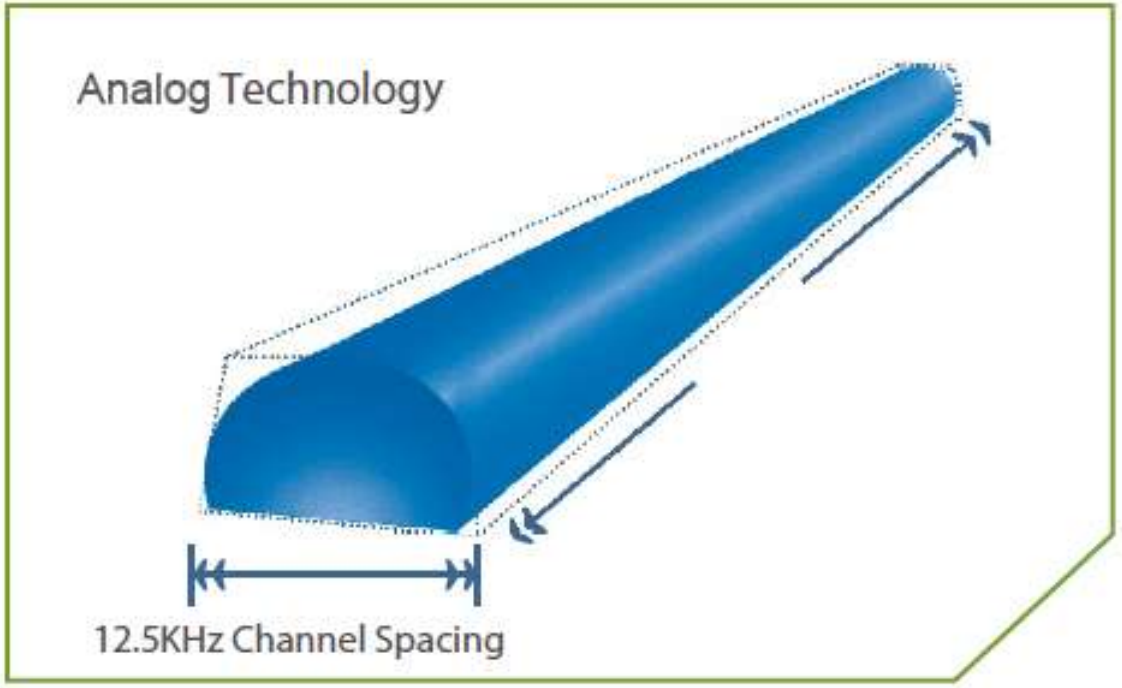
DMR Processing (cont.)

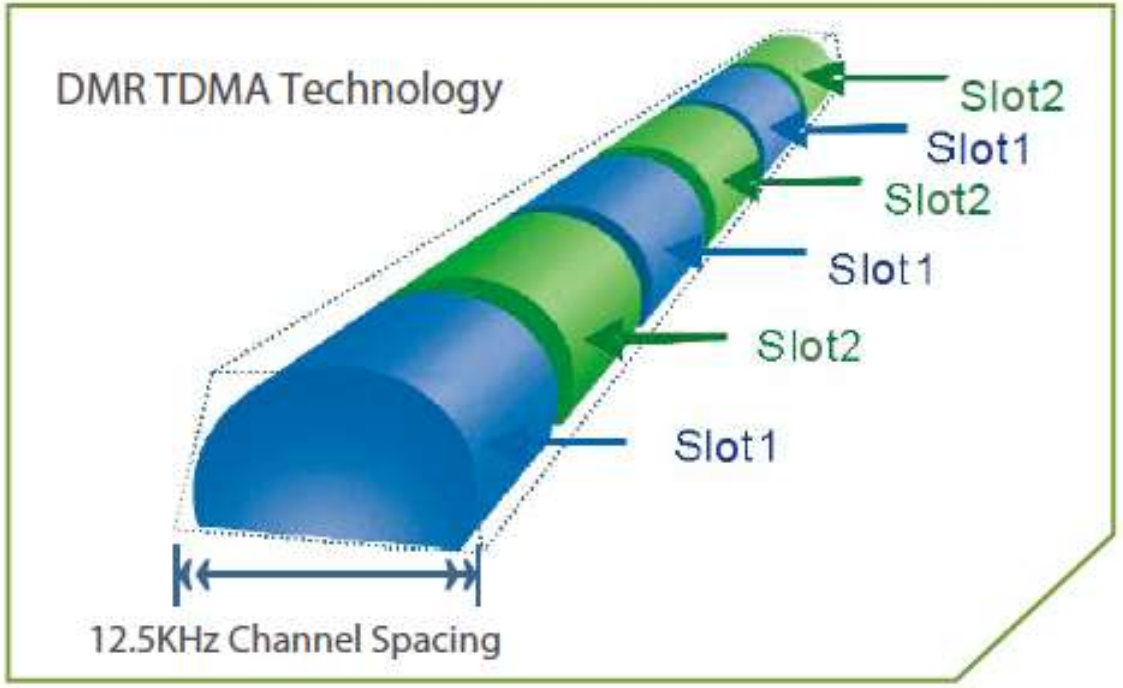
- DMR vocoder takes 30 ms of samples and compresses them



DMR Processing (cont.)

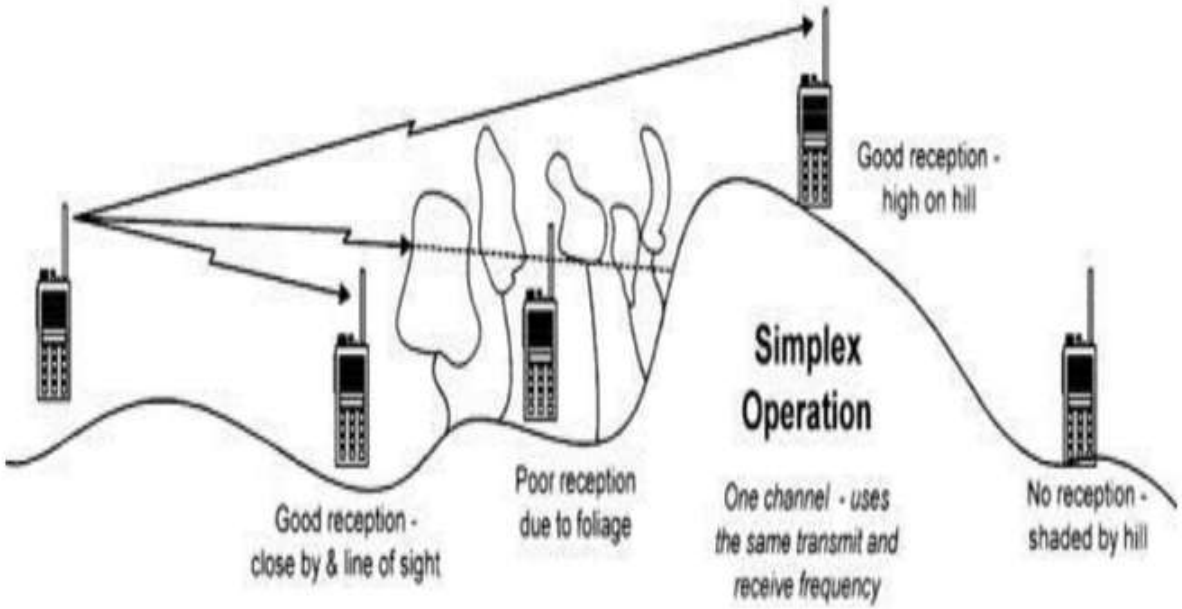
- It uses TDMA (Time Division Multiplexing)





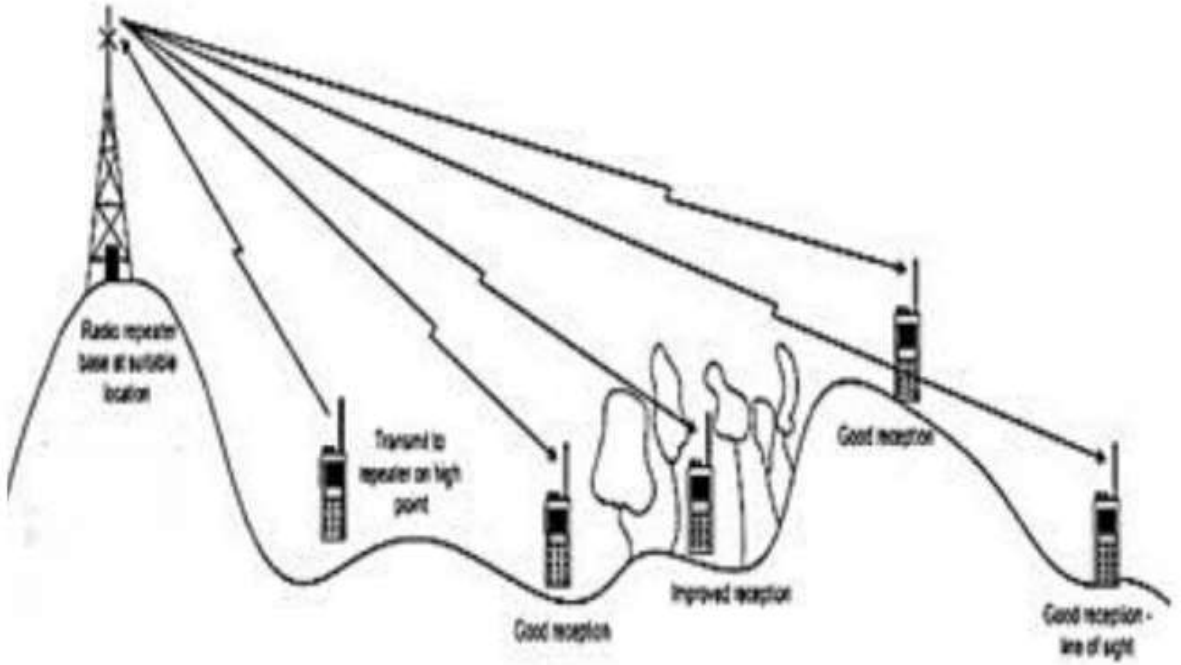
DMR Protocol

- 3 Tiers of protocol (Ham radios use Tier 1 & Tier 2)

Tier 1 – radio to radio	

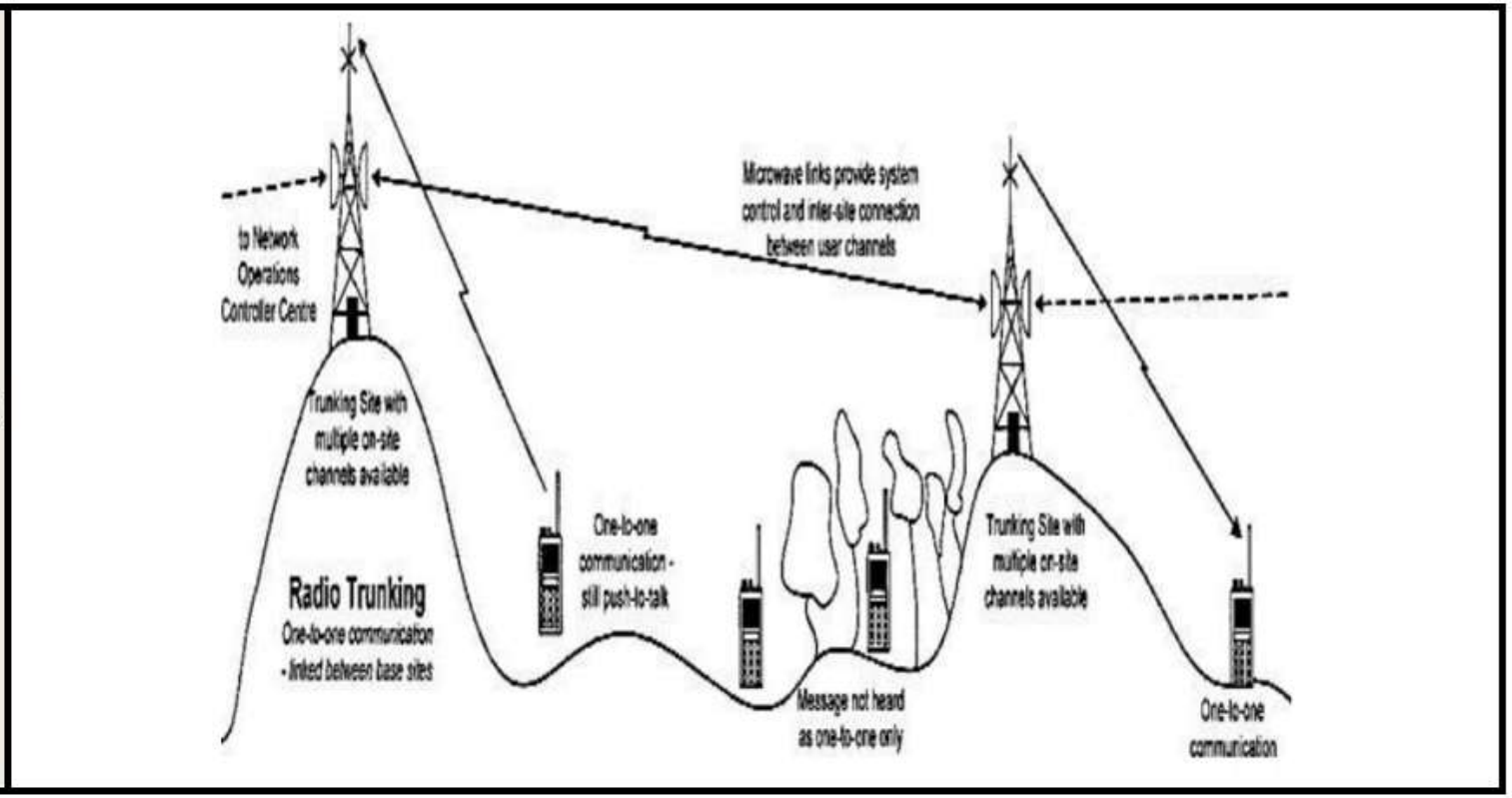
How does DMR get your voice into a digital signal?
Sampling

DMR Protocol (cont.)

Tier 2 – radio to repeater	

DMR Protocol (cont.)

Tier 3 – between repeaters and network servers



What are TGs

- TGs are numbers are defined by the network server. Some of the Network Servers providing DMR traffic:
  - Brandmeister
  - K4USD
  - DMR+
  - FreeDMR
  - TGIF
- Most of the GA repeaters use the K4USD network, some are Brandmeister

What are TGs (cont.)

- Talk Groups represent areas / groups that would have common communication
- TG defines where like minded operators are likely to reside
- There is no restriction who can subscribe / select / talk on a TG
  - a person in MN can just as easily joint the GA TG as the MN TG
- Anybody can connect to any TG as long as the repeater / server provides that TG

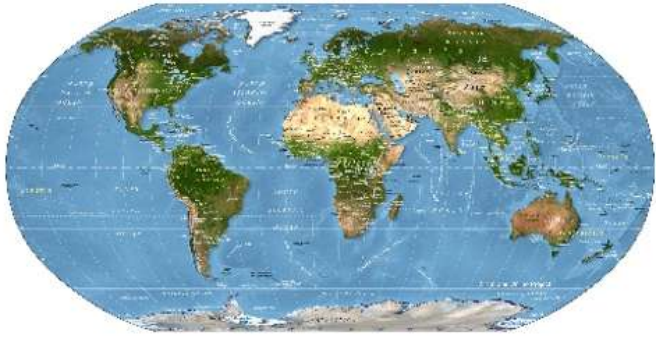
Some TG Designations

Local Metro Area
like Atlanta Metro
BM TG 9 & 31131

State Wide
like Georgia
BM TG 3113

Larger Area
like Southeast
BM TG 3174

World Wide
like Everybody, English
BM TG 91

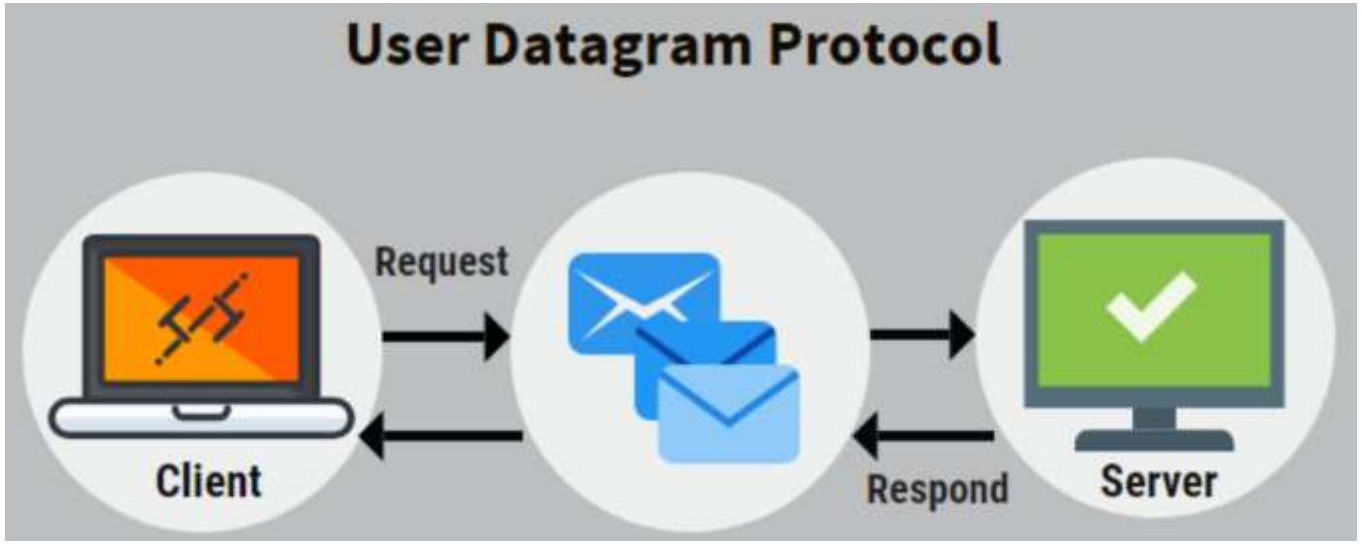


TG Designations (cont.)

- Not all Network Servers use the same TG number for a DMR Talk Group
- Certain TGs are shared – meaning that traffic on one network server is also available on a different network server
  - Example – TG 3113 (GA State) traffic appears on both K4USD and Brandmeister
  - This is a cooperation between the 2 networks, and at times, can be interrupted
  - In general, TG on one network cannot be guaranteed to be on another network
- So, Georgia State TG 3113 on GA DMR repeaters (K4USD) is simultaneously on BM 3113 for access to Hotspots

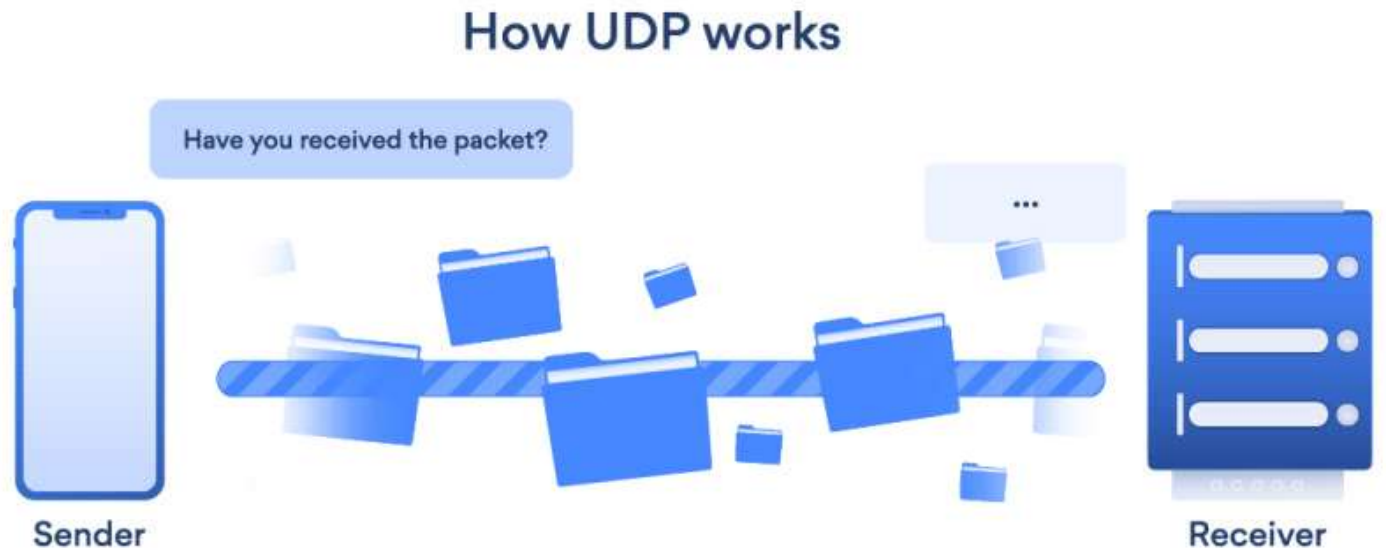
TGs use UDP

- UDP is a subscription system
- Request sent to the server – gets connected



TGs use UDP (cont.)

- Server sends the DMR TG stream
- Stream sent to Requester – a repeater, hotspot or radio requesting TG subscription number



How TGs are selected

- There are 2 types of TG selection:
  - Static – all traffic on the TG is sent without need to initiate a subscription
  - PTT (Part Time TG) – traffic only sent after the TG subscription is initiated
- Setting up a static TG
  - Repeaters have local or state TGs as static
  - Hotspot can set the static TGs by configurations – done depending on the network connected to
  - Static TGs are assigned to a TS

TG Sending

- All radios receive the same traffic that are connected to the repeater – it is not radio specific
- Radios can show TS has traffic – receiving light indicator
    - They will hear traffic if “tuned” to the TG being sent

TG Switching

When a TS does not have TG traffic, it can be switched to a different TG – using PTT (Part Time TG connection)

- Allowed PTT TGs are assigned by a repeater and are assigned to a particular TS
- PTT connections have time limits – set by the repeater or server
- PTT is started and the timeout is initiated when a radio sends on the TG
- PTT time interval is reset whenever a radio sends on the repeater PTT TG
- Once a PTT TG is selected, there is a timer preventing another PTT TG from being selected … like 5 minutes
    - Also a length timer for PTT – PTT TG traffic ends

Radios can Select when to transmit

Radios have controls on what to allow the radio to transmit to a repeater (every radio calls these controls different names)

- Transmit only if both TSs are free of traffic (eg: Same Color Code)
- Transmit only if the TS is free of traffic (eg: Channel Free)
- Transmit even if there is traffic from a different repeater (eg: Different Color Code)
- Transmit without restrictions (eg: Always) – this is also considered “Impolite Mode”

Repeater vrs Hotspot

Repeater

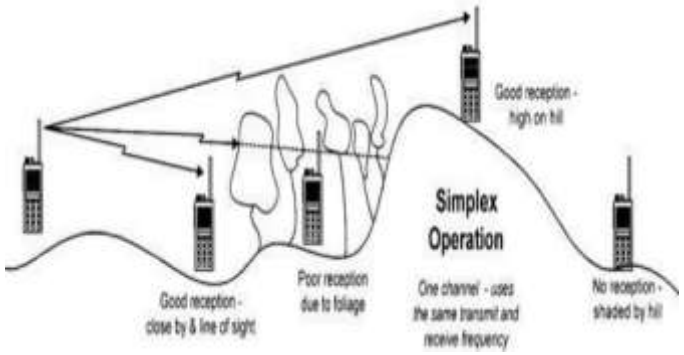
- Uses both TS
- Only allows TGs that it wants – selection of ones provided by the Network Server it uses
- Specifies the TS the TG is assigned to

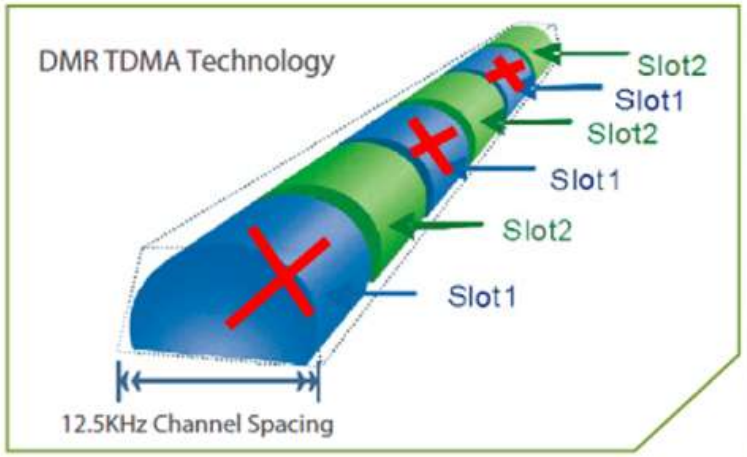
Hotspot

- Can connect directly to network servers
- Can access any TG network server supports
- You have control over static and PTT TGs
- 2 versions – Simplex and Duplex

Simplex?

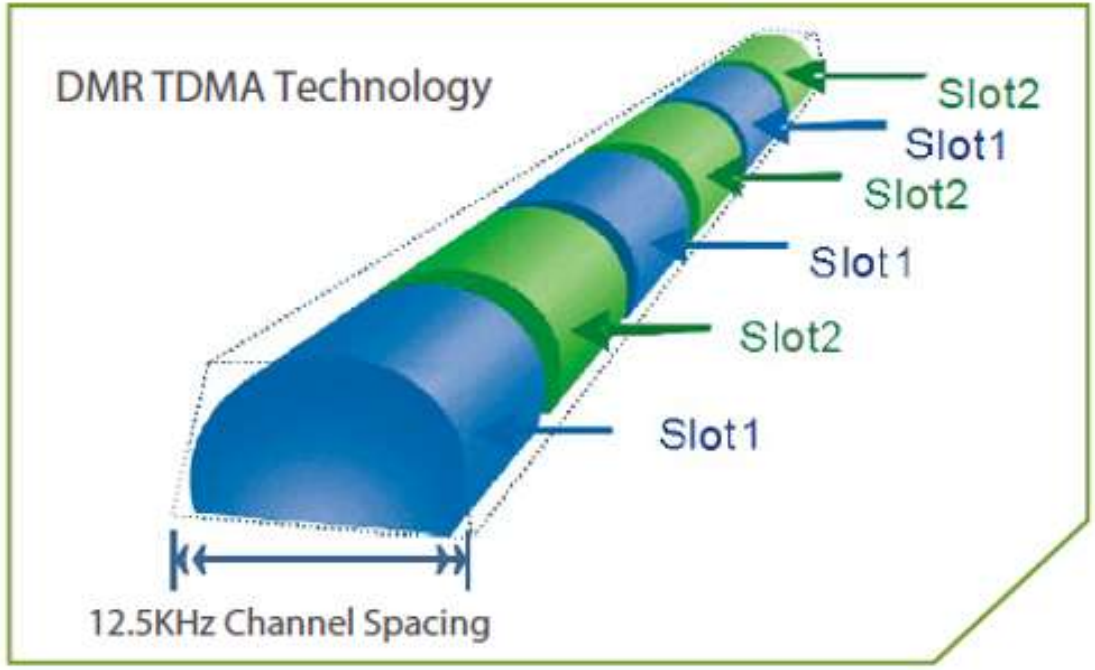
- Means HT to HT communication – there are specified frequencies for 2m and 70cm
- Means a Hotspot that only uses 1 of the TSs (TS 2) … only has 1 antenna





Duplex Hotspot

- Hotspot usus both TSs
- Has 2 antennas
- Can always have a TS free



Using CPS (Customer Programming Software)

Simplified codeplug Workflow (in order):

a. Populate User info (DMR ID, Name, Cal Sign)
b. Create Group Call List (Talkgroup list)
c. Create Channels (also Analog channels in this step)
d. Create Zones
e. Customize buttons, tones, display
f. Save finished codeplug
g. Write to radio

CPS (cont.)

Your Radio

Needed to enter:

- DMR ID & Call Sign
- TG List (broadcast area)

Then:

- put in Channels
- assign Channels to Zones (group of Channels)

Finally, load digital contacts to get call sign of contact

CPS (cont.)

Each TG between the Radio and the Repeater / Hotspot requires a Channel defined in the Radio.

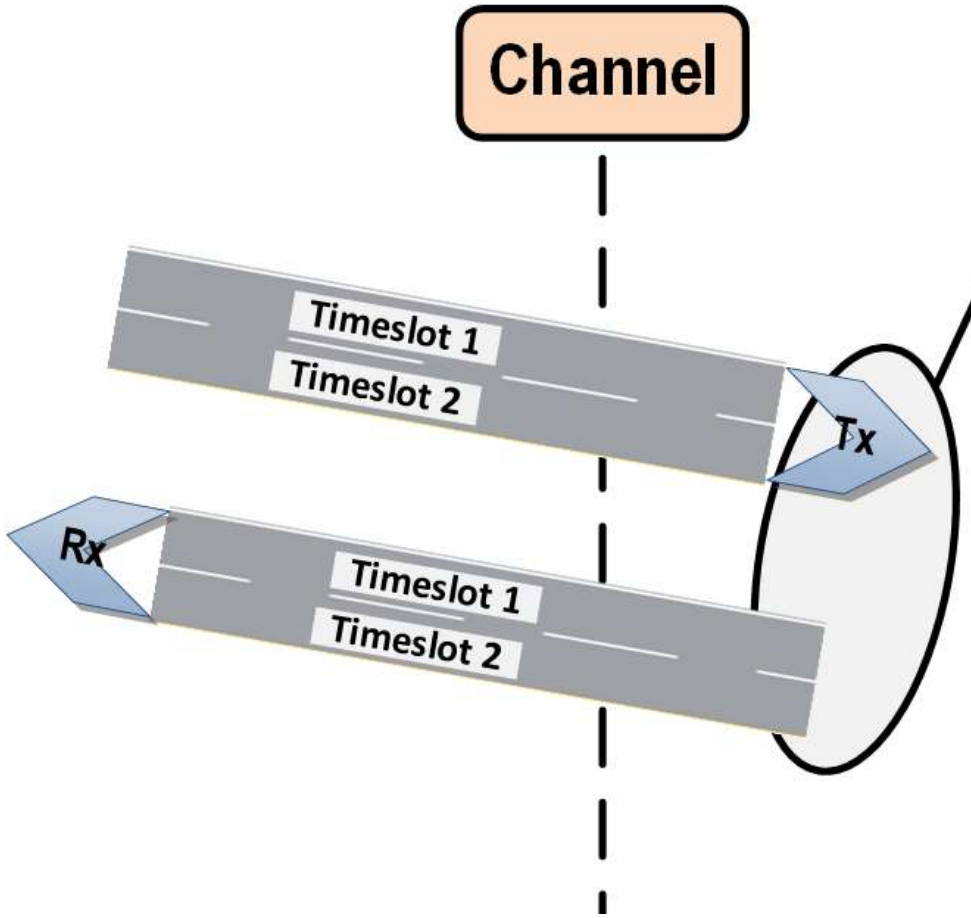
Each Channel contains:

- Tx frequency
- Rx frequency
- Color Code
- Access (Tx Permit / Admit Criteria)
- TG
- Timeslot

Same for each Channel to the same Repeater / HotSpot

Channel Specific

CPS (cont.)



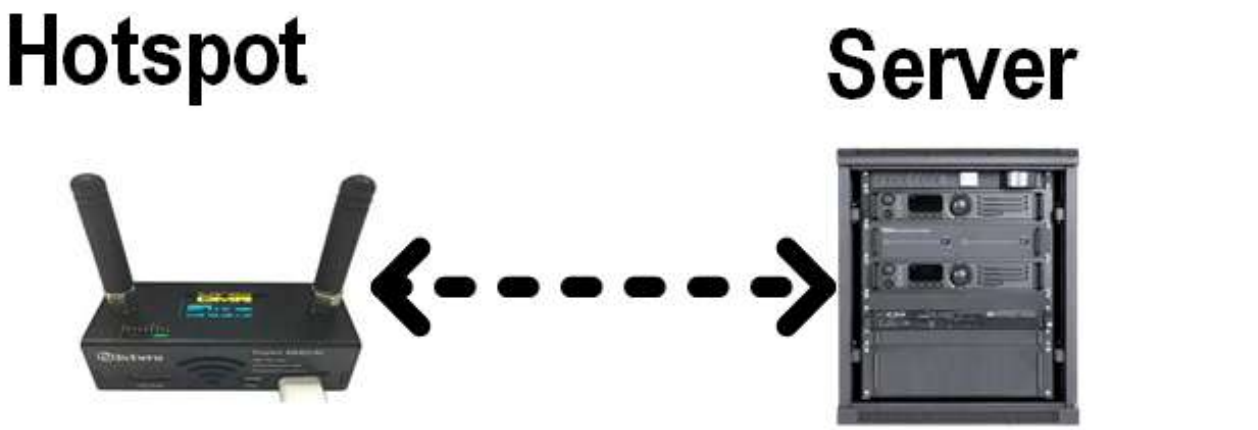
All Channels going to a single Repeater / Hotspot are placed in a the same Zone (*Think of Zones as folders to use, and logically group channels for repeater or hotspot.)*

Repeater

Each Repeater lists:

- TGs Supported
- Static TGs
- Color Code (access to Repeater 0-15)
- Tx frequency
- Rx frequency

CPS (cont.)



Hotspot Configured with:

- Color Code
- Tx frequency
- Rx frequency
- Available Timeslots:
  - Duplex TS1 & TS2
  - Simplex TS 2

TGs Supported thru Hotspot or Repeater