DMR

Jan (KD7ZWV)

Murray Amateur Radio Club

What is Digital Radio?

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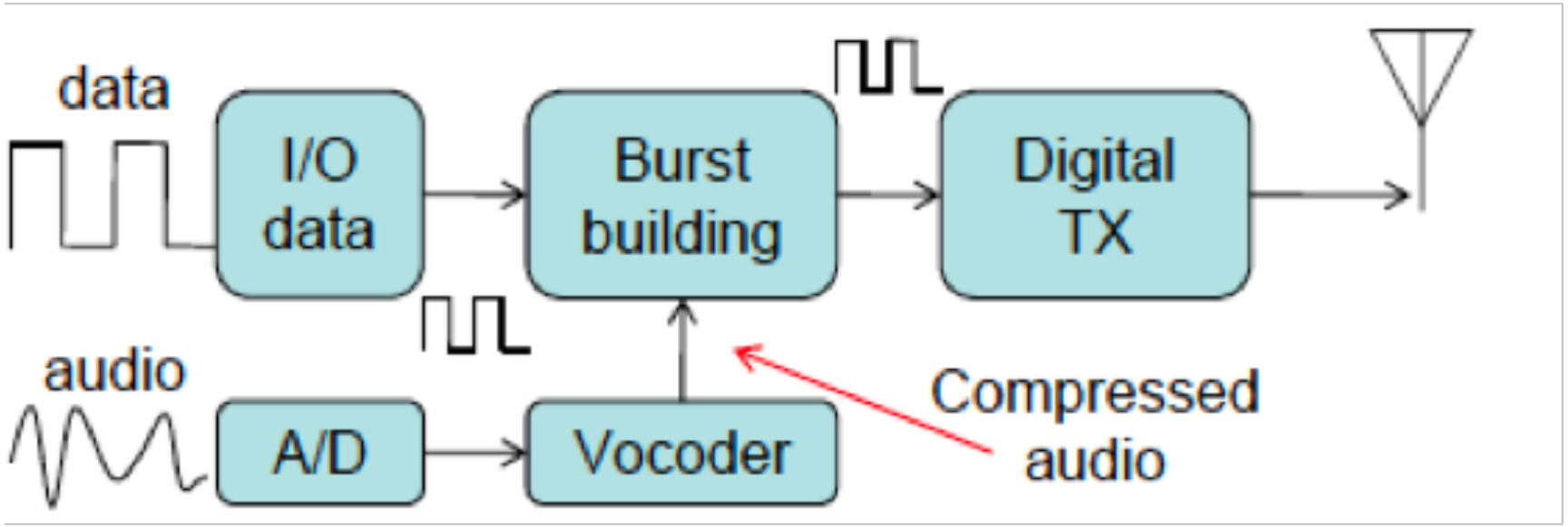
  - Data can be sent/received directly

What is Digital Radio?

- Radio Block Diagram



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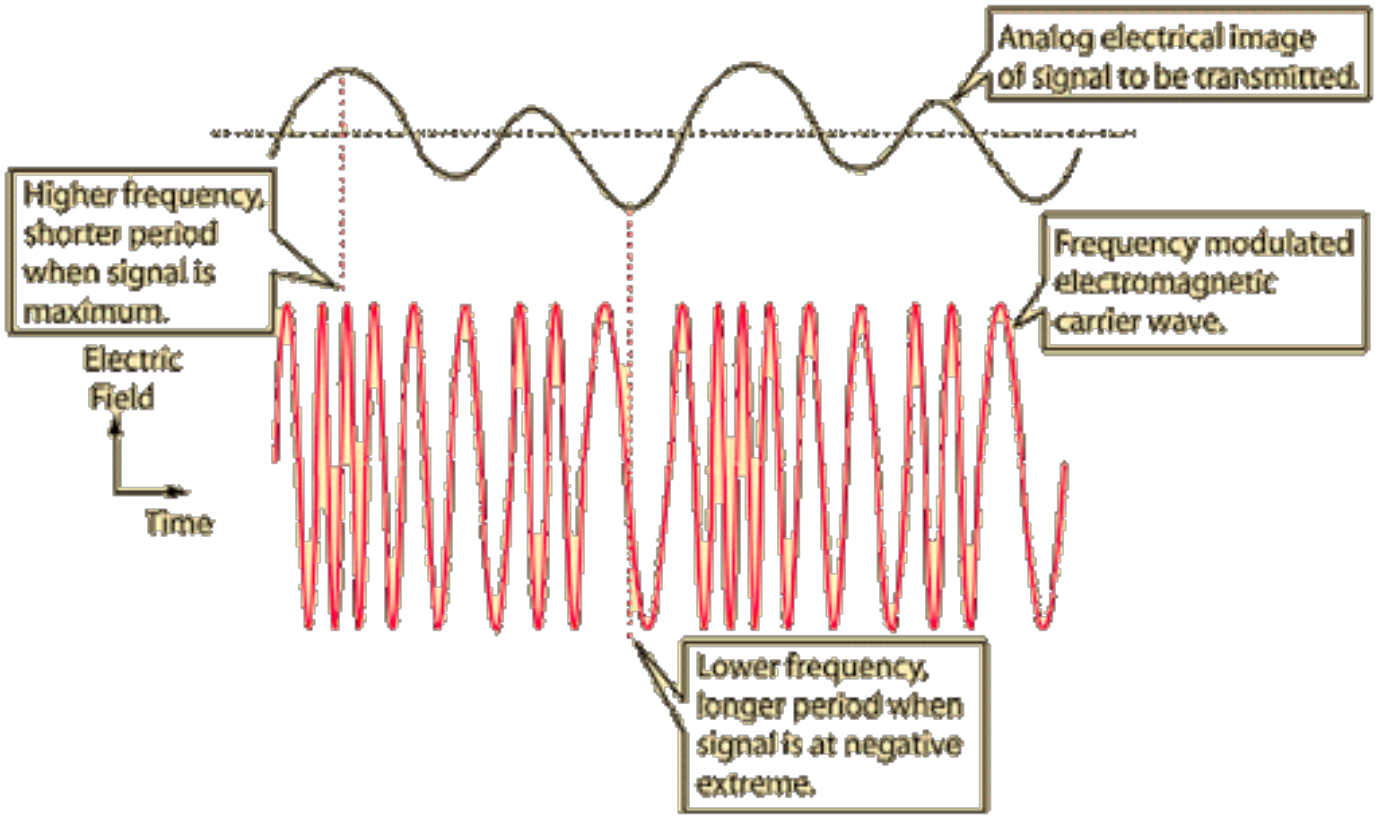
  - DMR
- These implementations are NOT compatible with each other

Digital vs. Analog

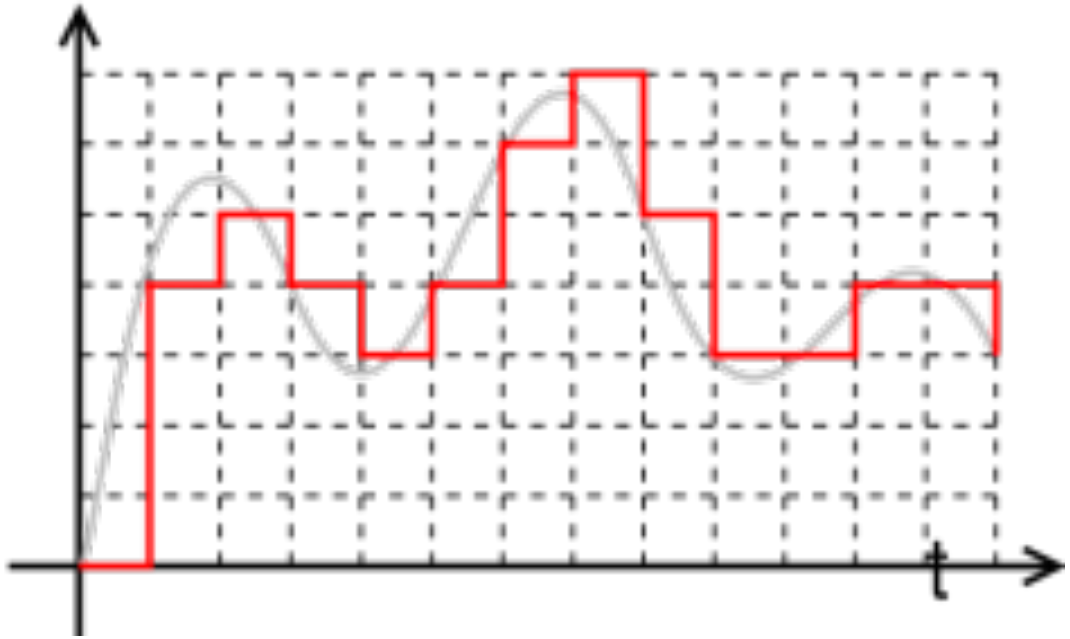
Digital vs. Analog

- Analog



Digital vs. Analog

- Digital



0 4 5 4 3 4 6 7 5 3 3 4 4

000 100 101 100 011 100 110 111 101 011 011 100 100

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- Multiplexing different data streams
  - digital stream can be “sliced and diced” to multiplex several data streams into one signal

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- Sounds a lot like FRS, doesn’t it?

So What is DMR?

- Digital Mobile Radio
- ETSI (European Telecommunications Standards Institute) Standard
- Used world-wide by professional radio services
- Standard defines three “tiers” or classifications of usage
  - Tier 1 – single channel, 6.25 kHz bandwidth, created for European “unlicensed” use
  - Tier 2 – two channel, TDMA, 12.5 kHz bandwidth, supports peer-to-peer and repeater operations, typically used by amateur deployments

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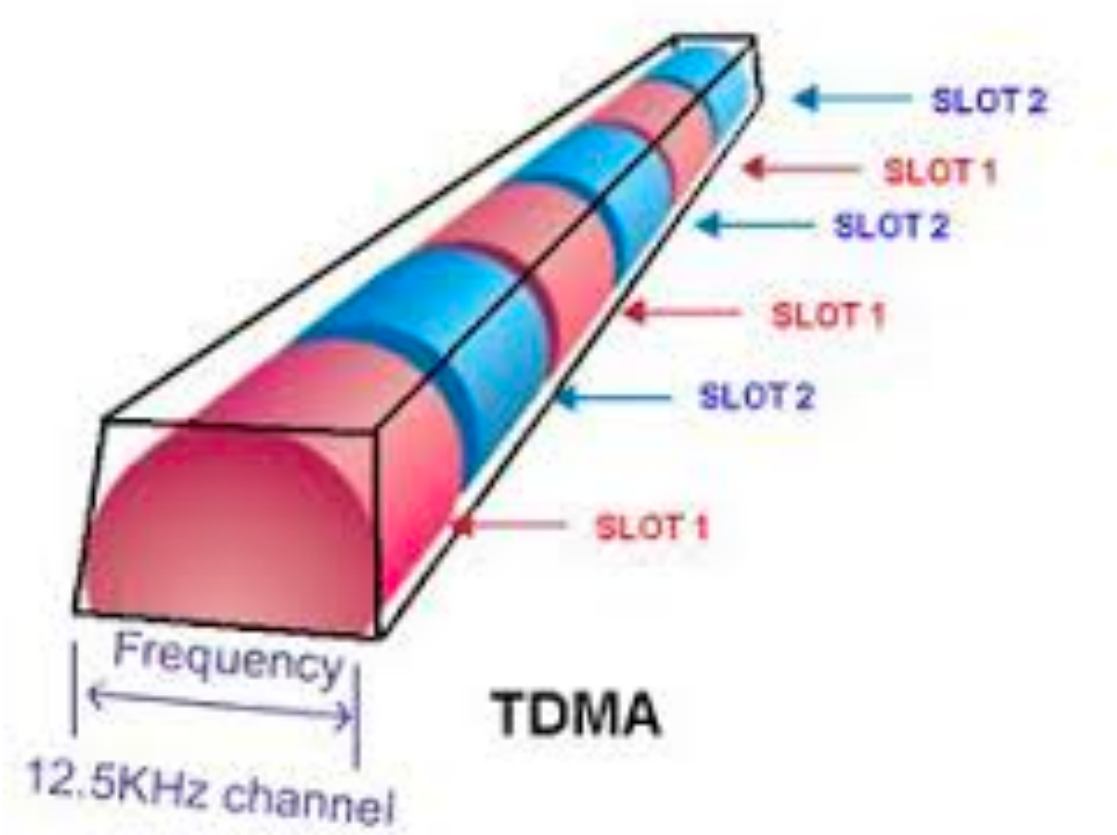
DMR Tier 2

- TDMA



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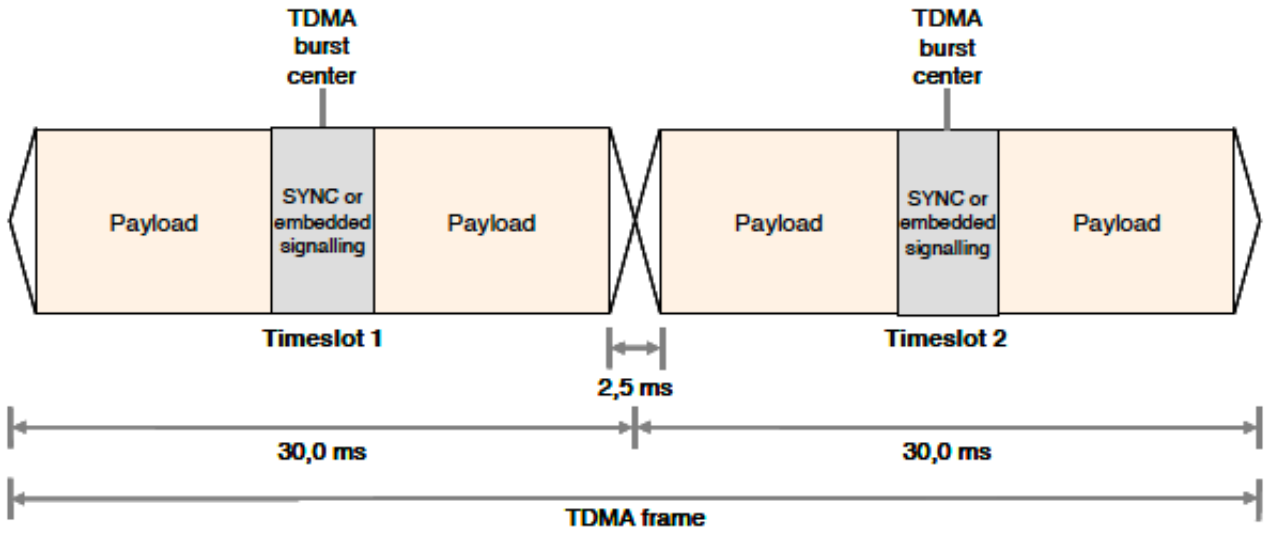
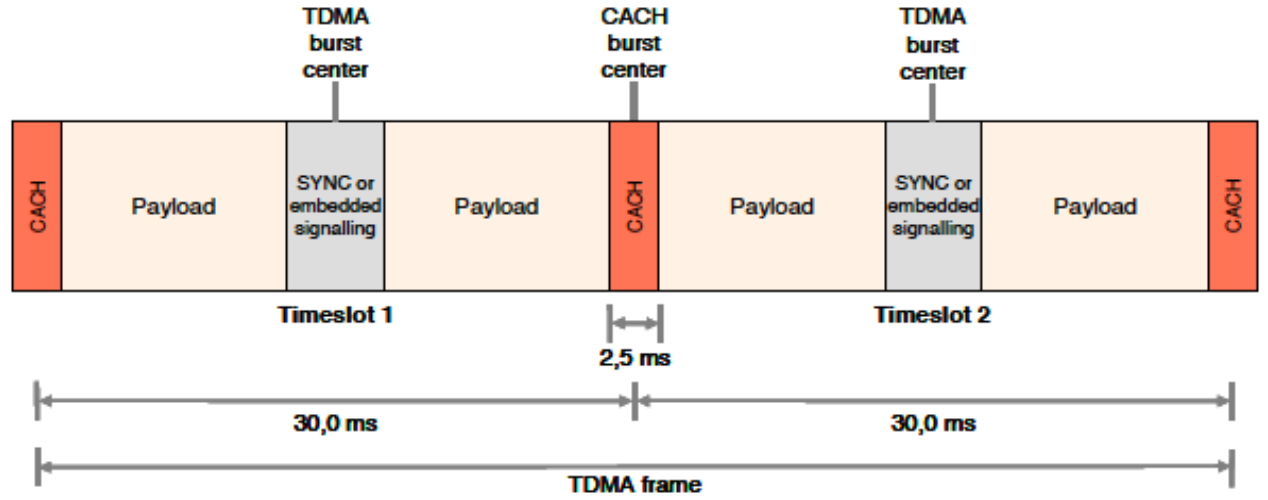
- TDMA – Time Domain Multiple Access, two channels: “Time Slot 1” and “Time Slot 2”
- each channel/time slot gets 30ms out of each 60ms
- the 30ms window is broken down to 27.5 ms of “frame” and a 2.5 ms “gap”
- the 27.5 ms frame can carry 264 bits
  - 108 bits of payload, 48 bits of SYNC data, and another 108 bits of payload
  - the 2.5 ms gap is filled with CACH (Common Announcement Channel) data on the repeater side

DMR Tier 2

- Handset signal



- Downlink signal (repeater)



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- each channel can carry either voice or data (or a combination of the two)

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  - Tier 1 – single channel, 6.25 kHz bandwidth, created for European “unlicensed” use
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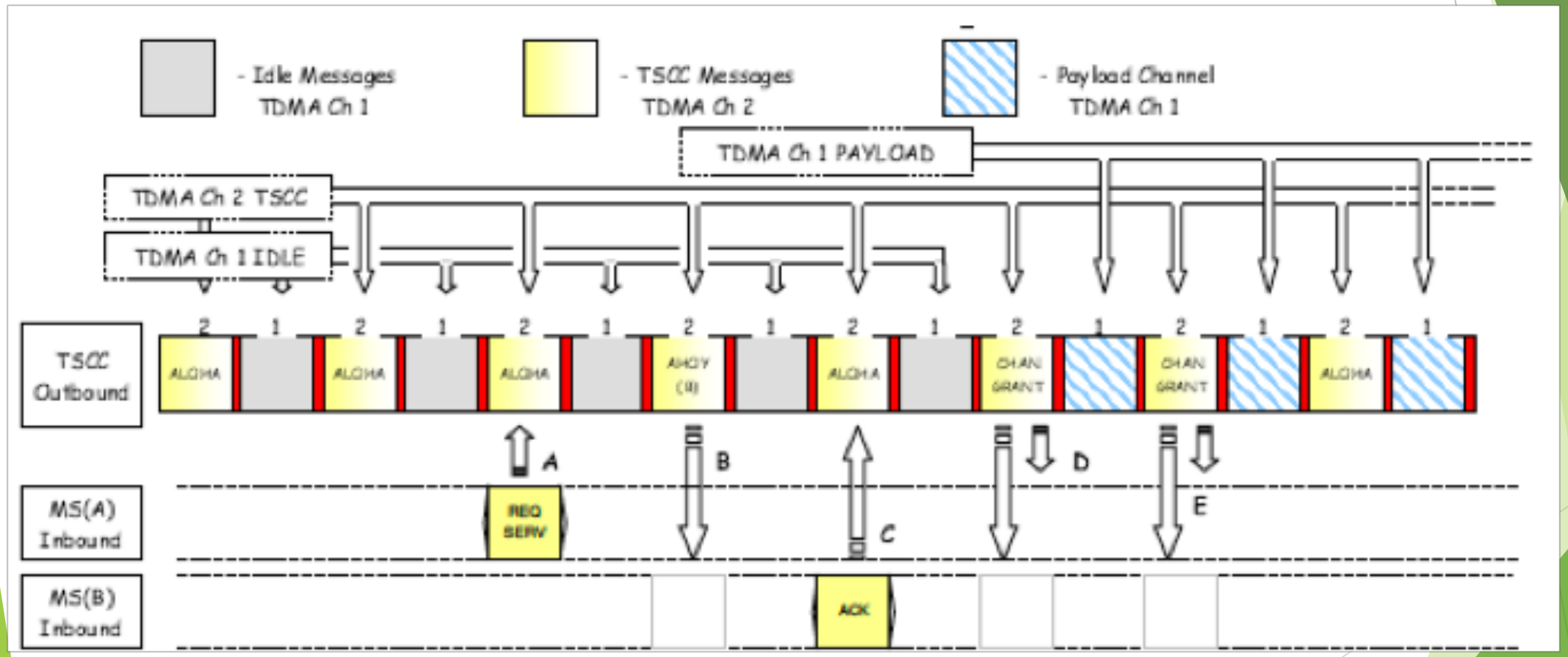
  - Tier 3 – extensions to tier 2 to add trunking and support for multiple repeaters at a single site, some vendor specific incompatibilites for trunking support and multi-site interconnections

DMR Tier 3


- Idle Messages
TDMA Ch 1
- TSCC Messages
TDMA Ch 2
- Payload Channel
TDMA Ch 1
TDMA Ch 1 PAYLOAD
TDMA Ch 2 TSCC
TDMA Ch 1 IDLE
TSCC Outbound
ALOHA
ALOHA
ALOHA
AHOY (R)
ALOHA
CHAN GRANT
CHAN GRANT
ALOHA
A
B
C
D
E
MS(A) Inbound
REQ SERV
MS(B) Inbound
ACK

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- Talk Groups

Talk Groups

- Kind of like FRS “privacy” tones
- Multiple talk groups can be supported on a single time slot by a single repeater
- You can have your radio “subscribe” to specific talk groups
- You will only hear those talk groups that you are subscribed to
- “Private Call” is an individual talk group specific to you and one other station

Talk Groups in Utah

Talkgroup	ID	Timeslot	Detail / Use
Local 1	1	1	Local Repeater Only
Local 2	2	2	Local Repeater Only
Worldwide	91	1	Worldwide (Short QSO's)
N America	93	1	North America (Short QSO's)
Simplex	99	1	Simplex Frequencies
USA	3100	1	United States
Utah	3149	2	Utah Statewide TS 2
Utah	3149	1	Utah Statewide TS 1
76ers	31490	1	UARC 76ers
Northern Utah	31491	2	Northern Utah
Echo Test	9990	1	Private Call - Test Your Audio

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IPSC (Repeater Linking)

- IP Site Connect
- NOT defined by the ETSI standard
- Generally vendor specific (i.e., Motorola equipment can not link with Hytera)
- Allows repeaters to connect over the Internet
- Can use a system known as a c-Bridge to connect dissimilar networks together
- Allows talk groups to exist over a wide area (even world wide)

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- Zones (like memory groups, but better)

Zones

- Like Kenwood TM-D710 “super” memories
- Can program a zone for a specific set of repeaters/channels
  - zone for specific area: local, state, neighboring state
  - zone for specific purpose: normal, field day, emergency callout

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- Color Codes (think DCS or CTCSS)

Color Codes

- These are kind of like CTCSS/DCS on analog repeaters
- Sixteen “color codes” available
- Repeater will only hear you if you are on the right color code
- Use if multiple repeaters geographically close on same frequency

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- Code Plugs (super easy way to program your rig)

Code Plugs

- Simplified programming for your radio
- Put together your repeaters, channels, talk groups, etc.
- https://www.dmr-utah.net/codeplugs
  - Motorola XPR6500, XPR6550, XPR7550, SL7550, XPR4550, XPR5550
  - Hytera PD782G, X1p
  - Alinco/Anytone DJ-MD5, AT-D868UV, AT-D878UV
  - Tytera (TYT) MD380
- NOTE: Programming software works on Windows only

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- Roaming (automatic handoff to another repeater when you move around)
- Simplex (handset to handset without a repeater)
- Admit Criteria (how does your radio know when it can transmit)
- Battery Life (the transmitter is only on 27.5 ms out of every 60 ms)

What Do I Need to Play?

- Get a radio!
  - Commercial radios (Motorola, Hytera, Vertex Standard, Kenwood)
  - Non-commercial radios (TYT, Baofeng/BTECH, Anytone, etc.)
    - https://amzn.to/30wwPeL Anytone AT-D878UV+ $239
    - https://amzn.to/2BZfHnR Baefeng DM-1801. $70
    - https://bit.ly/3dTLFA5 Ham Radio 2.0 Youtube Playlist for DMR Radios
- Get a Digital ID
  - you only need one no matter how many radios you have
  - https://www.radioid.net/register
- Get a Code Plug
  - DMR-Utah is a good source
  - https://www.dmr-utah.net/codeplugs

NOTE: these are Amazon Affiliate links

What Else Do I Need/Want?

- Digital Hotspot
  - Low power, Simplex, acts like a DMR repeater right in your own shack!
  - Many support multiple digital modes like D-Star, P25, DMR+, YSF and NXDN
  - Typically use a Raspberry Pi and a transceiver daughter board
  - https://amzn.to/2zoXT4F $106

Q and A

- References
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