Digital Mobile Radio Demystified

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VA3**XPR**

Agenda

- Digital Mobile Radio Overview

- Ham Radio Usage of DMR

- How to Get Started With DMR

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What is Digital Mobile Radio?

- Commonly known as "DMR"
- A standard for digital voice communications
- Published by the European Telecommunications Standards Institute (ETSI) in 2005
- The goal of the standard is to create digital systems that are:
  - Low cost
  - Low complexity
  - Interoperable between vendors

DMR Association

- A global organization focused on growing the DMR market
- Provides
  - Interoperability testing
  - Certification
  - DMR education, promotion and encourages discussion

DMR Association Members

The DMR Standard

- Specifies the air interface between radios

- 2-slot Time Domain Multiple Access (TDMA)

- 12.5 kHz channel width

- Digital modulation (4FSK)

- Frequencies between 30 MHz – 1 GHz

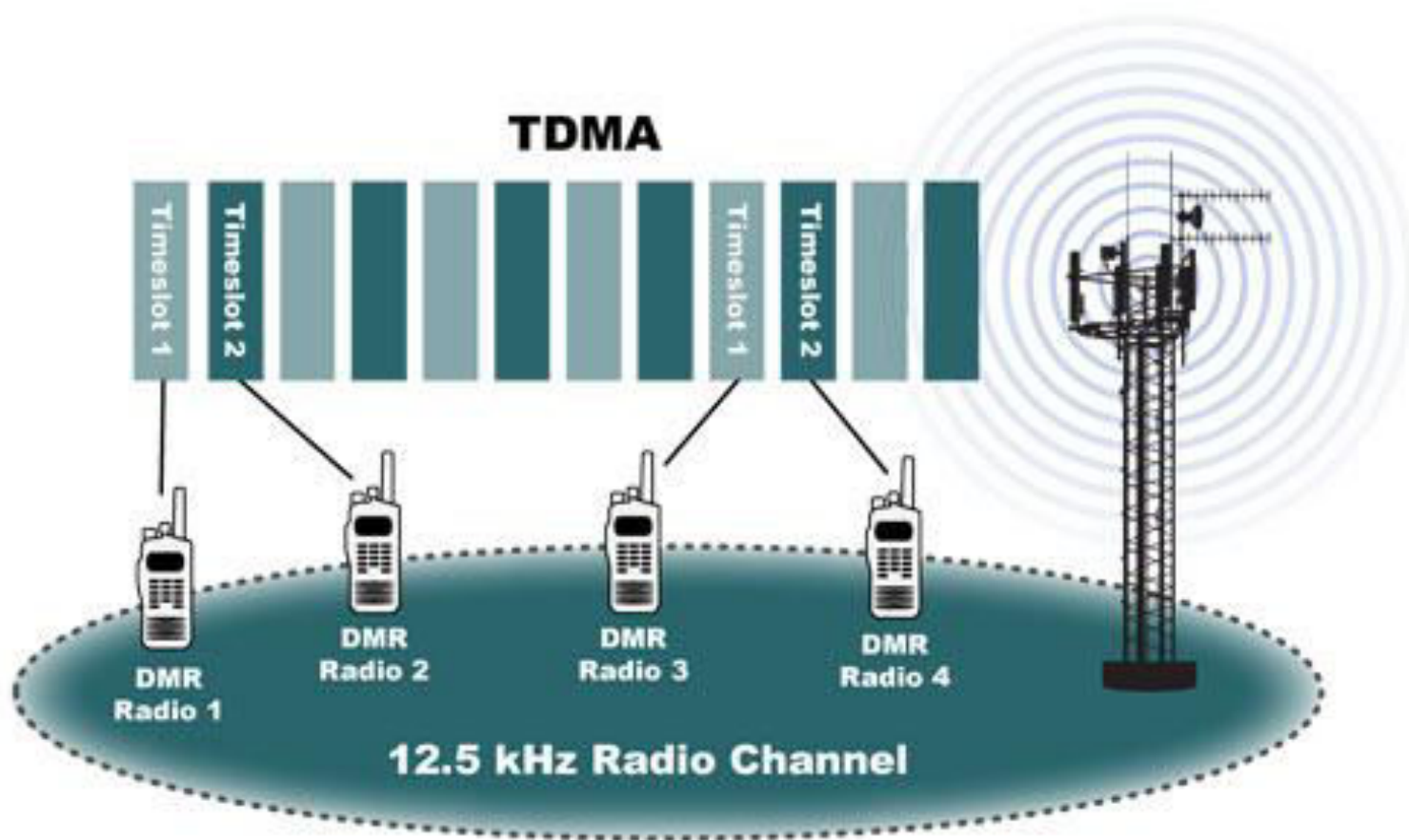- DMR Association members have agreed to use the AMBE+2 vocoder
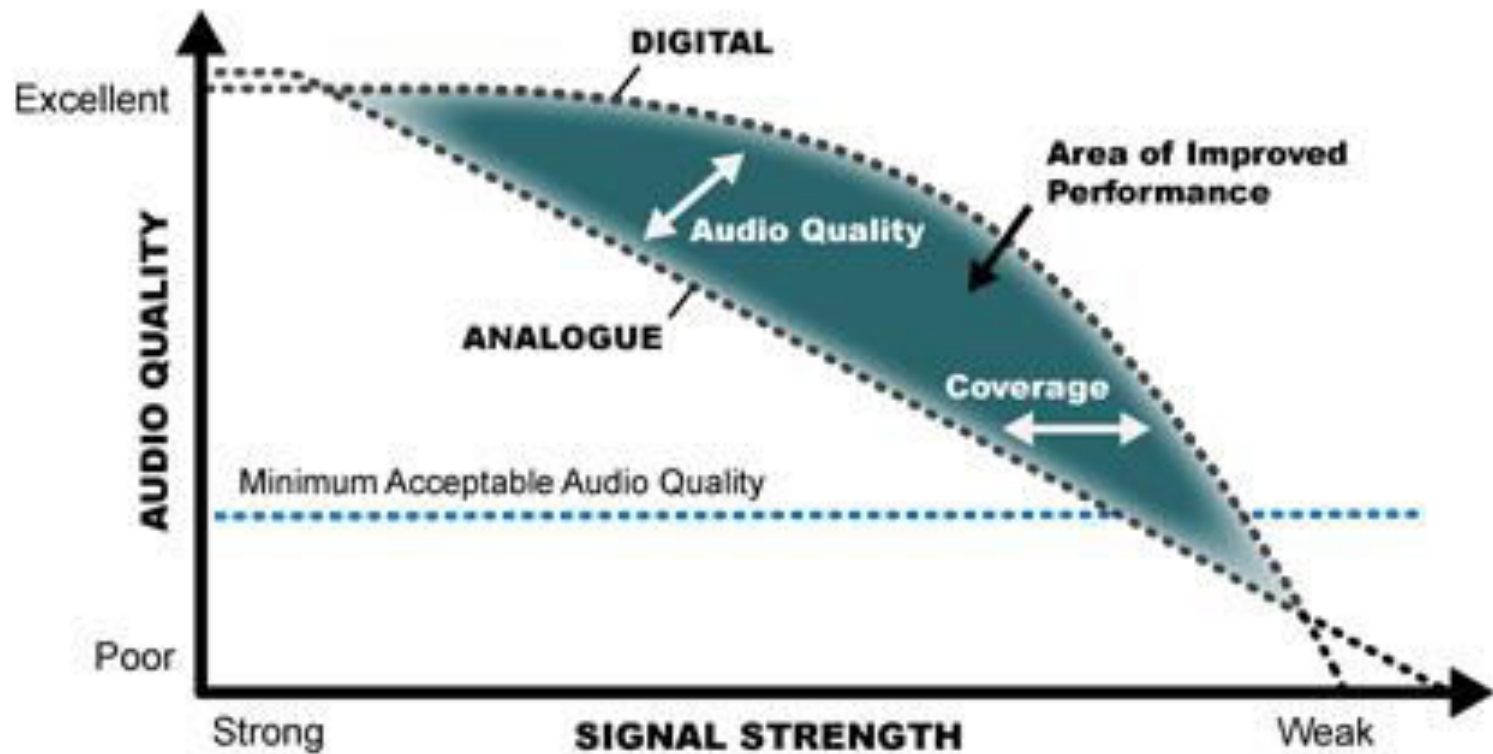
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Benefits of using DMR

- Allows 2 simultaneous voice conversations using a single repeater – like having 2 repeaters in 1 box!
- Improved audio performance over analog
- More efficient use of radio spectrum vs. analog
- Longer battery life vs. analog
- Lowest total cost of ownership for clubs as compared to other ham digital voice modes
- +12 DMR radio manufactures = lower radio prices
- Capable to being linked to over 800 other DMR repeaters worldwide
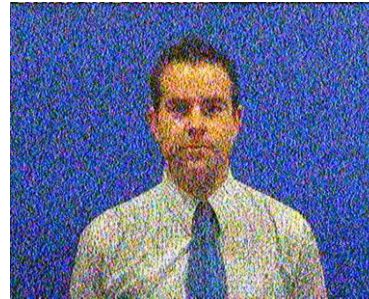
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Simultaneous Voice Conversations

TDMA

Timeslot 1 | Timeslot 2 ... Timeslot 1 | Timeslot 2

DMR Radio 1 | DMR Radio 2 | DMR Radio 3 | DMR Radio 4

12.5 kHz Radio Channel

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Improved Voice Performance

Analog vs. Digital Comparison

Decreasing Signal Strength
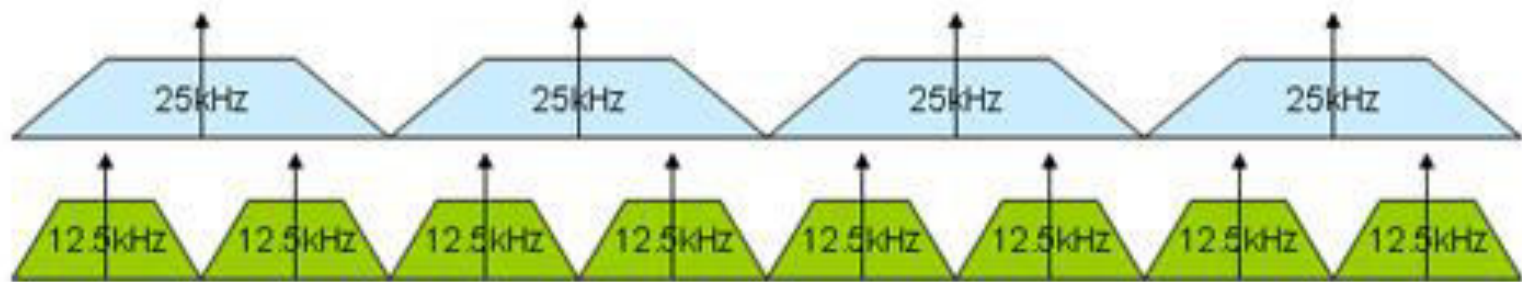
Analog

Digital

No Signal

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Efficient Use of Radio Spectrum

DMR provides **4x** as many voice conversations using the same spectrum as FM @ 25 kHz

1 x 25 kHz Channel	1 FM repeater	1 voice conversation
	2 DMR repeaters	4 voice conversations

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Longer Battery Life

"For each hour of usage the TDMA radios show between 19% and 34% less battery capacity is required than for the FDMA models."

"By cutting the effective transmit time in half, two-slot TDMA can enable up to 40 percent improvement in talk time in comparison with analogue radios."

- DMR Association

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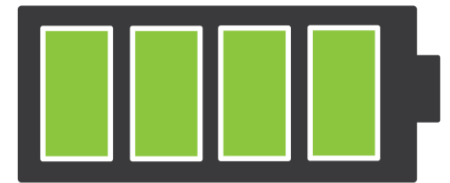
Feature Comparison

	System Fusion (Yaesu DR-1X)	D-STAR (ICOMID-RP4000V)	DMR (Motorola XPR8400)
Simultaneous Conversations	1	1	2
Channel Width (kHz)	12.5	6.25	12.5
RF Power Output (W)	50	30	45
Digital IP Linking Capable	Yes[1]	Yes	Yes
Dual mode capable (digital/analog)	Yes	No	Yes[2]
Dual band capable (2m/70cm)	Yes	No	No
Compatible Radio Manufacturers	1	1	+12
Warranty (years)	1	2	2

Notes
1. Using optional purchased Wires-X interface
2. Optional purchased feature

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Lowest Total Cost of Ownership

Example: A ham radio club with 20 members

	Quantity	System Fusion	D-STAR	DMR
Digital Repeater	1	$620[1]	$1,548[6]	$1,800[2]
Programming Software & Cable	1	$0	$0	$375
Digital Portables	20	$6,000[3]	$6,000[5]	$3,980[4]
TOTAL		**$6,620**	**$7,548**	**$6,155**

Notes
1. Yaesu special pricing for clubs only for the DR-1X repeater @ $500. Add HRI-200 Wires-X interface @ $120
2. Motorola XPR8400 pricing from a ham friendly dealer
3. Yaesu FT1DR-HD @ $300 each
4. Connect Systems CS700 @ $199 each
5. ICOM IC-ID31A @ $300 each
6. Includes ICOM special pricing for clubs only for the ID-RP4000V repeater @ $700 and ID-RP2C controller @ $848
7. All prices in USD

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Portable DMR Radios

**Motorola
XPR7550
~$700 USD**

**Motorola
XPR6550
~$450 USD**

**Vertex
Standard
EVX-539
~$350 USD**

**Connect
Systems
CS700
~$180 USD**

**Motorola
SL7550
~$700 USD**

**Vertex
Standard
VXD-720
~$450 USD**

**Hytera
PD-782
~$585 USD**

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Mobile DMR Radios

Motorola XPR 5550
~$600 USD

Hytera MD782
~$565 USD

Motorola XPR 4550
**~$450 USD**

Vertex Standard
VXD-7200
**~$400 USD**

Ham Radio DMR Networks

- Several ham radio DMR networks
  - Ex. DMR-MARC and DCI
- Based upon Motorola's MOTOTRBO repeaters
  - ~96% of ham DMR repeaters are on 70cm band
  - 2m implemented in Maritimes, New England and California coast
- Worldwide Stats (Mar. 2015)
  - 12,000+ user IDs
  - 1,000+ repeater IDs
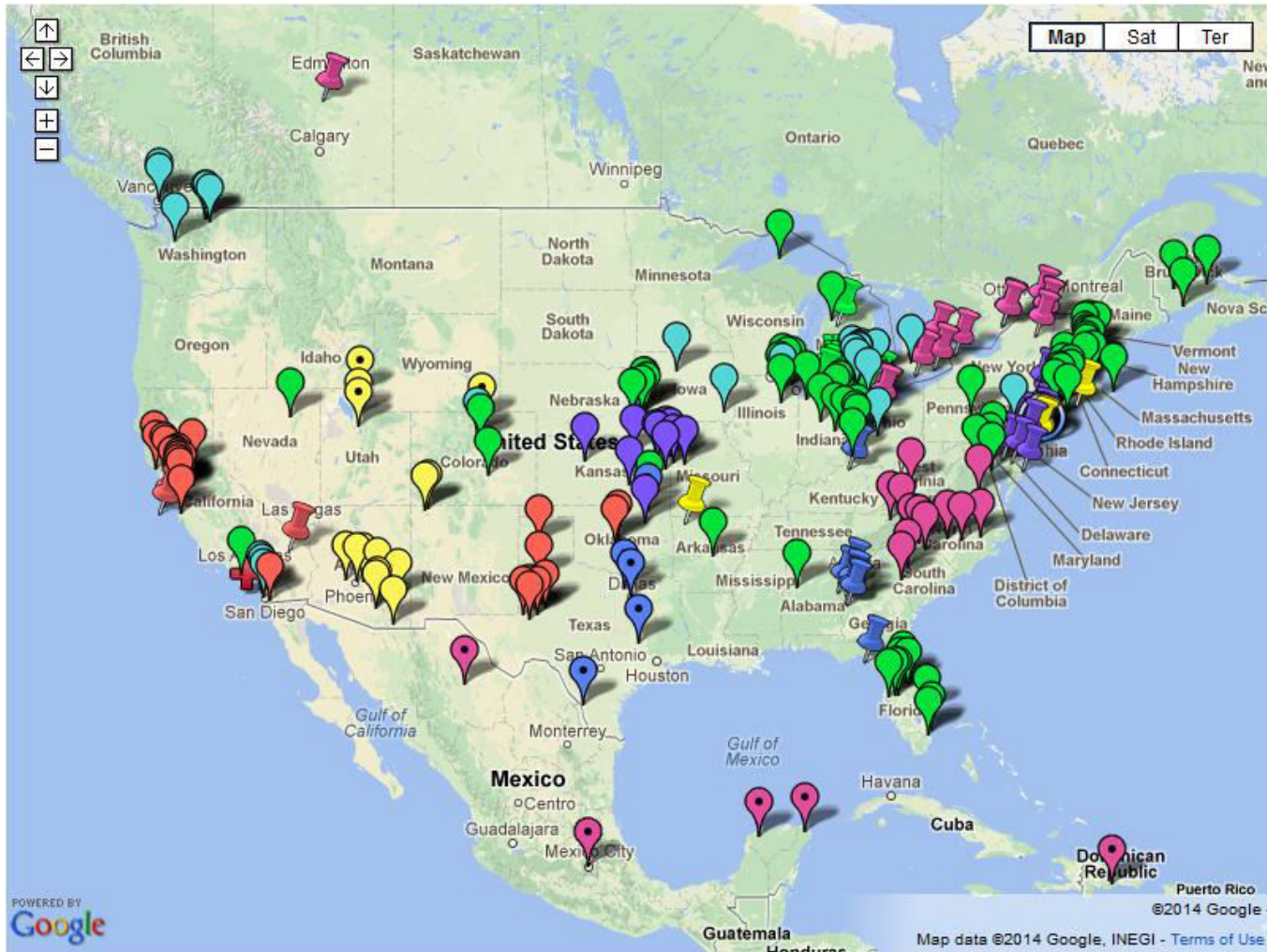 - 37 countries connected

Ham Radio Growth of DMR

156% User ID growth in 2014!!!

Legend: Repeater IDs (blue), User IDs (red)

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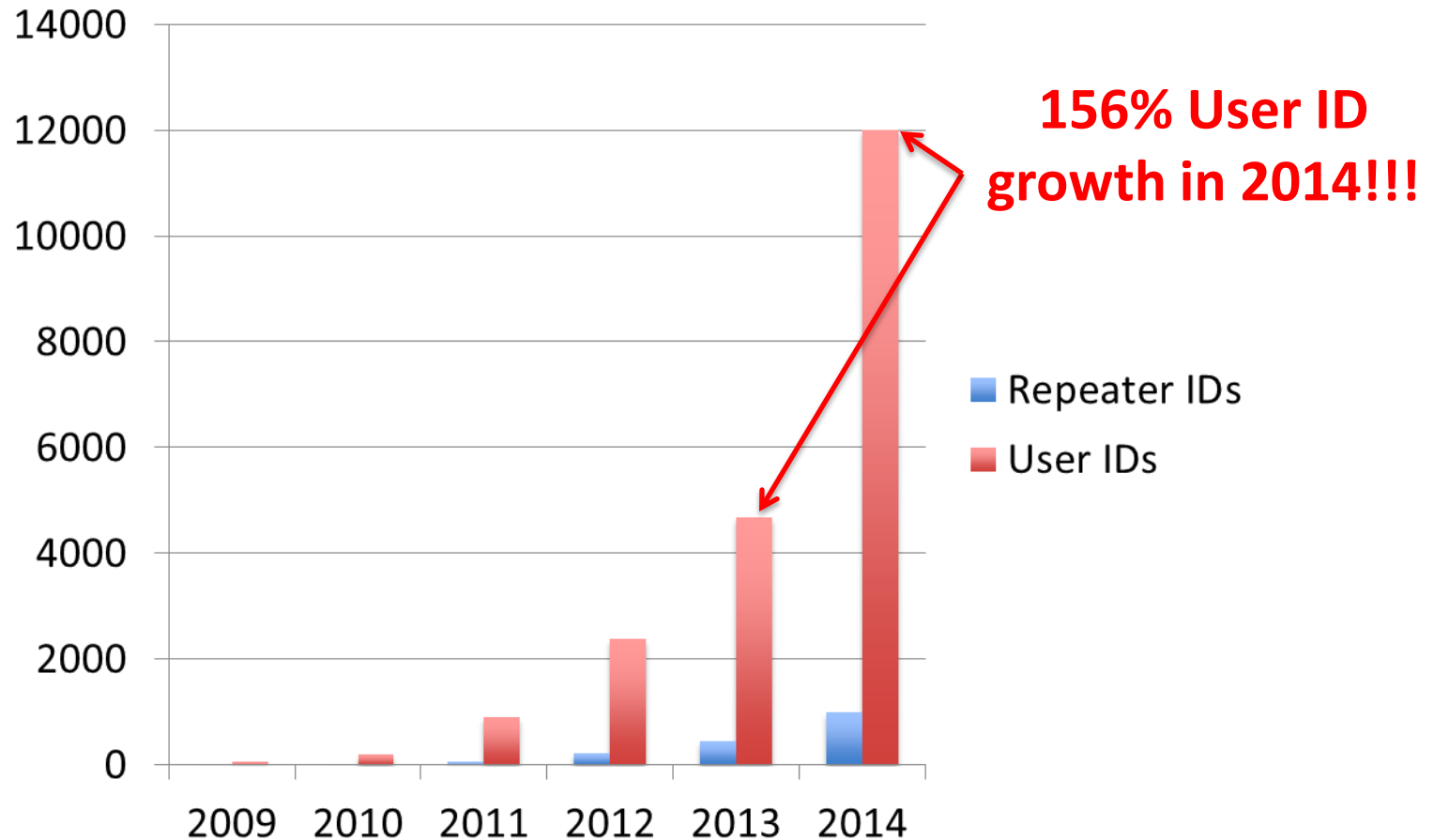
Network Architecture
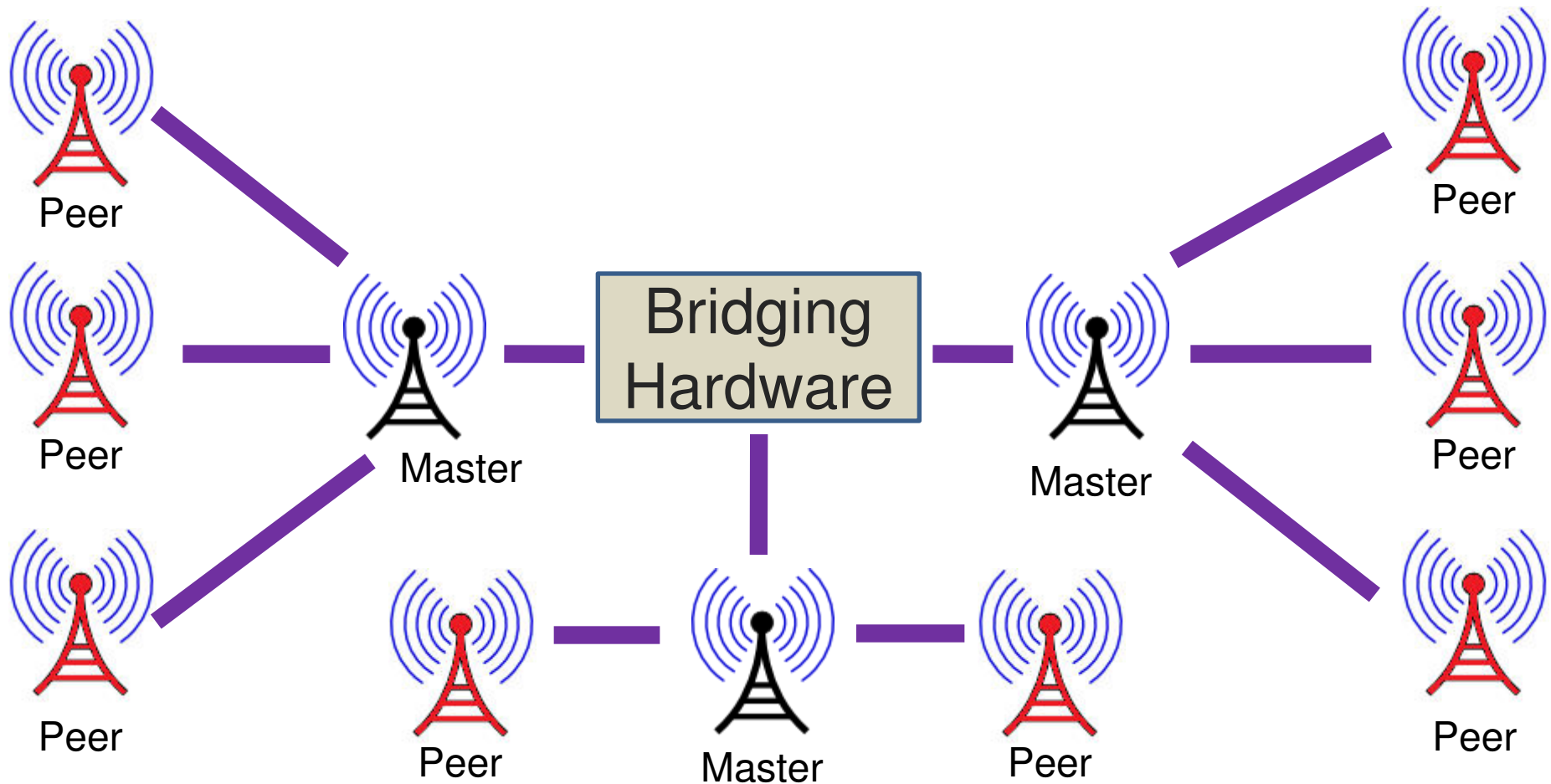
Network Map - Worldwide
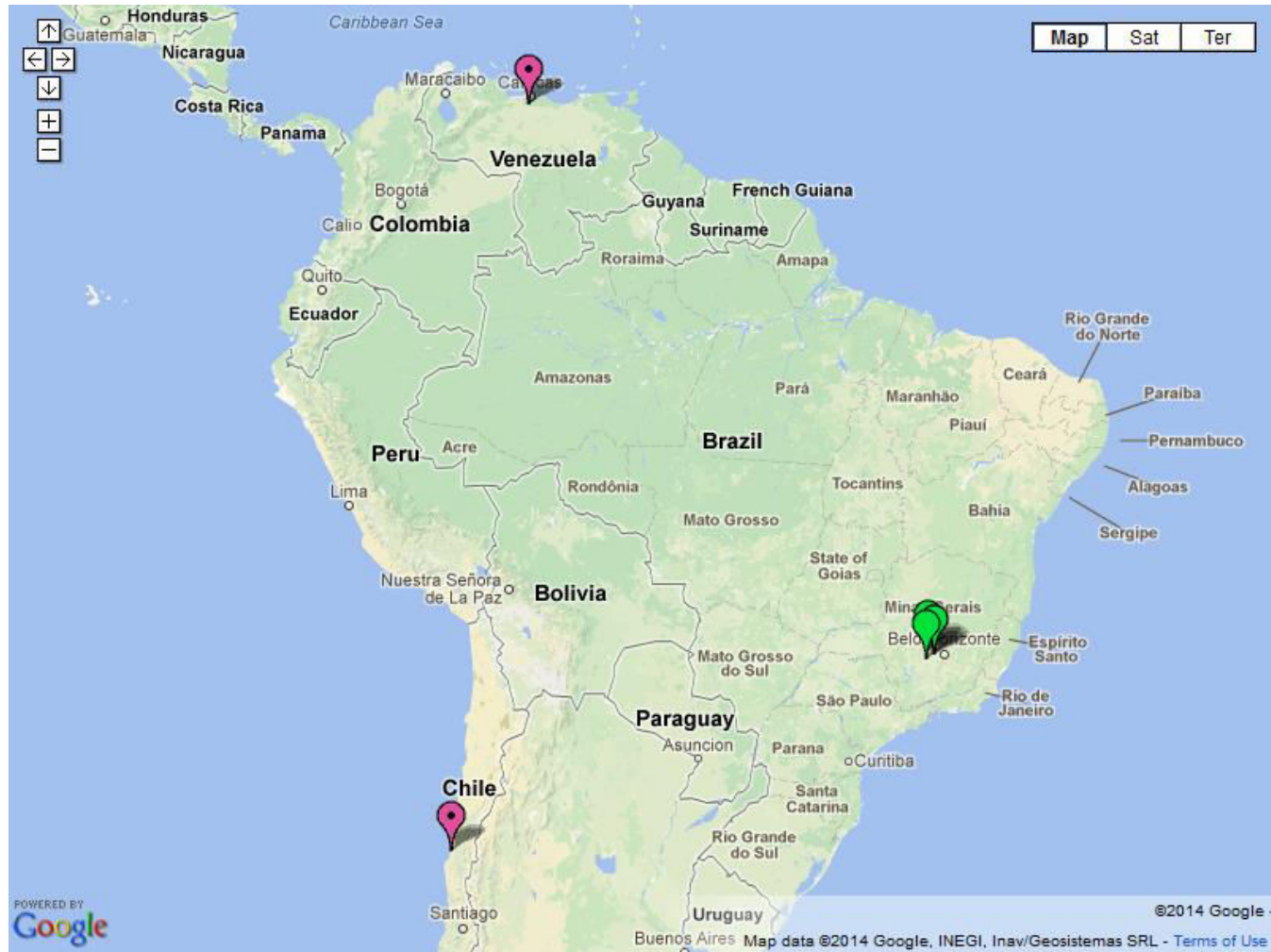
Network Map – North America

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Network Map - Europe

Network Map – Asia Pacific

Network Map – South America

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Network Map - Africa
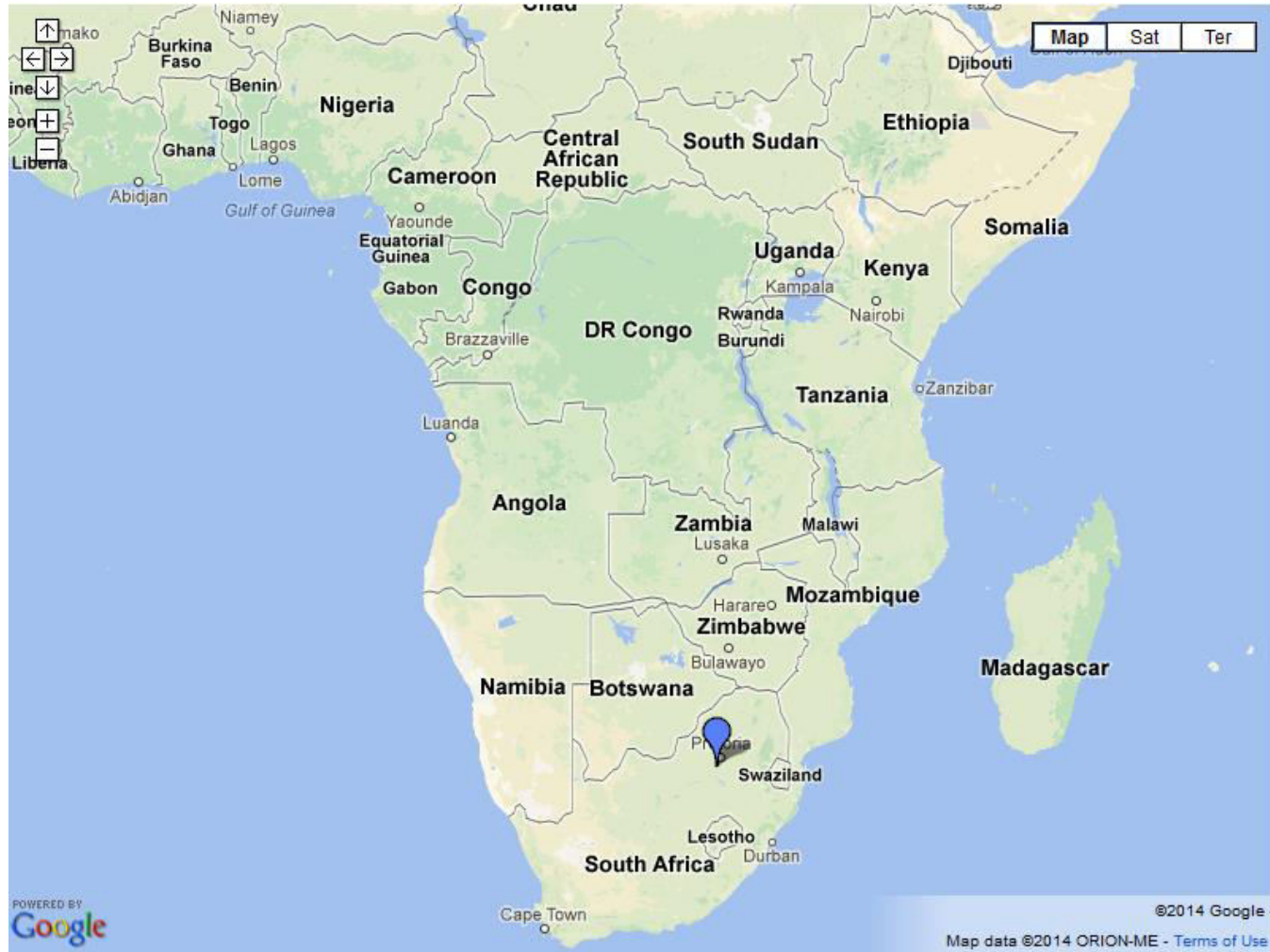
Ham DMR Network Definitions

TERM	DEFINITION
Talkgroup	A virtual radio channel, typically assigned by geography or language
Timeslot	A brief interval to which a DMR radio, especially a repeater, accepts data from another radio. For DMR there are two (2) 30ms timeslots
Colour Code	A number that is analogous to the a PL or CTCSS tone used during analog FM operation
C-Bridge	A server that bridges together regional DMR networks
User ID	A unique number assigned to each radio on the DMR network. Also known as a "Subscriber ID" or a "Radio ID"
CPS	Short for Customer Programming Software, which is the software used to program a DMR radio
Vocoder	A synthesizer in a DMR radio that converts analog voice to digital data
Master	A DMR repeater that connects to a c-Bridge on a ham DMR network. All other DMR repeaters that connect to the network through the "master" and are called "peers"

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Features of Ham DMR Networks

FEATURES	BENEFITS
Multiple Talkgroups	Allows users to access groups of other users by geography or language by simply keying their radios. No node numbers to dial or remember
Dual Timeslots	Allows 2 simultaneous conversations using a single repeater. Like having 2 repeaters on one frequency
Text Messaging	A quick and convenient way to send messages to a group or a single person
Roaming Capability	Allows DMR radios to switch between repeaters automatically
Remotely IP Programmable Repeaters	Allows the repeater sponsors to make changes from home
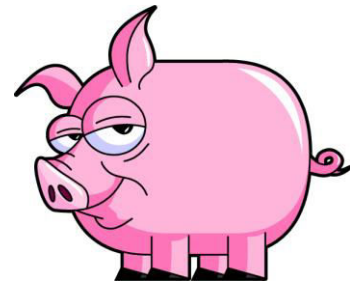
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Timeslots and Talkgroups

TIMESLOT 1 – Global, continental and national talkgroups
TIMESLOT 2 – Regional, provincial/state and local talkgroups

Sample talkgroups available on VA3XPR in Toronto, Canada

TIMESLOT	TALKGROUP	COVERAGE	CONNECTION	TIMEOUT
1	1	Worldwide	On-demand	5 min.
1	13	Worldwide English	Permanent	N/A
1	3	North America	Permanent	N/A
1	302	Canada-wide	Permanent	N/A
1	310	TAC 310	On-demand	5 min.
2	3023	Ontario-wide	Permanent	N/A
2	2	Greater Toronto Area	Permanent	N/A

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Getting Started as a DMR User

1. Check that you're within the coverage area of a DMR repeater

2. Request a User ID

3. Obtain a DMR radio and the required programming hardware & software

4. Program your DMR radio

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Setting-Up a DMR Repeater

1. Obtain a Motorola MOTOTRBO DMR repeater
2. Obtain a coordinated or non-interfering repeater frequency on either 2m or 70cm
3. Secure a location for your repeater that has a high-speed Internet connection (500 kbps minimum)
4. Apply to join a DMR network, such as DMR-MARC

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For More Information

http://www.va3xpr.net

http://www.dmr-marc.net

http://www.trbo.info

http://www.facebook.com/groups/DigitalMobileRadio/

http://groups.yahoo.com/groups/MOTOTRBO/

Questions?