DMR: THE FUTURE OF TWO-WAY DIGITAL RADIO

By Mike Swiatkowski, AA9VI (aa9vi@arrl.net)
Free permission to reuse for amateur presentations – MAY 2013

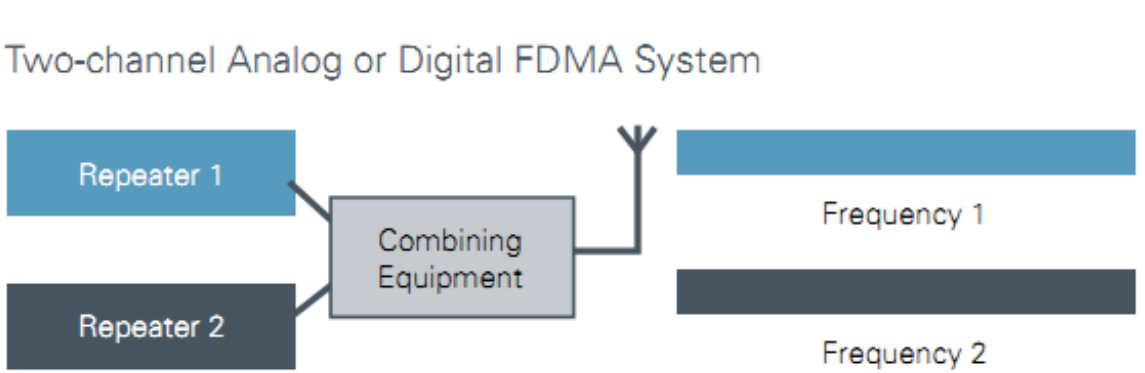
DMR
DIGITAL MOBILE RADIO ASSOCIATION

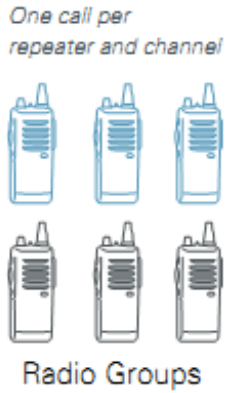
Digital Mobile Radio

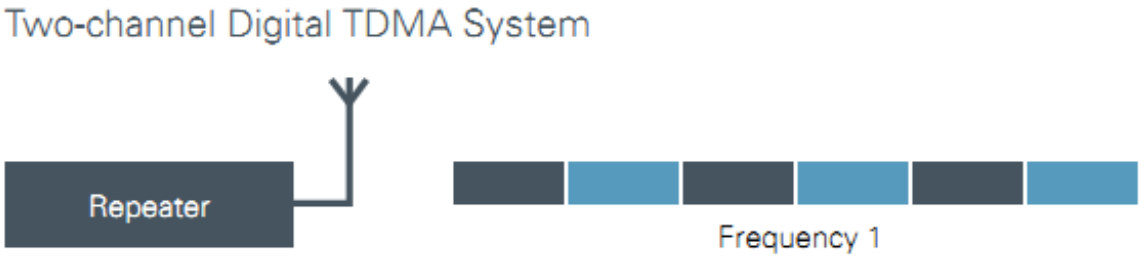
- An ESTI published worldwide standard
- Over a HALF DOZEN manufacturers of DMR radios
- Superior voice quality over older digital modes
- Longer battery life
- Supports multiple talk groups on one channel
- Supports data applications
- Commercial ETSI/TIA specs mean rugged performance over temperature and congested urban RF environments

TWO Repeaters in One!

TDMA saves licensing and equipment costs by enabling the equivalent of two 6.25 kHz channels within a single licensed 12.5 kHz channel



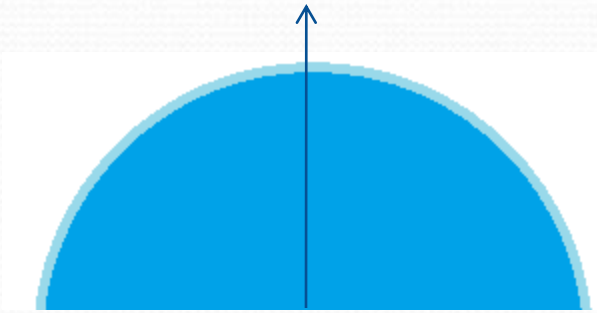




Lower infrastructure cost, 1 box in rack

TWO voice channels from one repeater

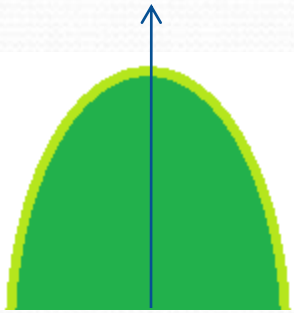
Half the Channel Bandwidth



f_c - 12.5 f_c f_c + 12.5

Traditional Analog
25 kHz
Channel Bandwidth

1 Channel
1 Repeater



f_c – 6.25 f_c f_c + 6.25

DMR
12.5 kHz
Channel Bandwidth

2 Channels
1 Repeater

More Spectrum Efficient than Older Digital Modes

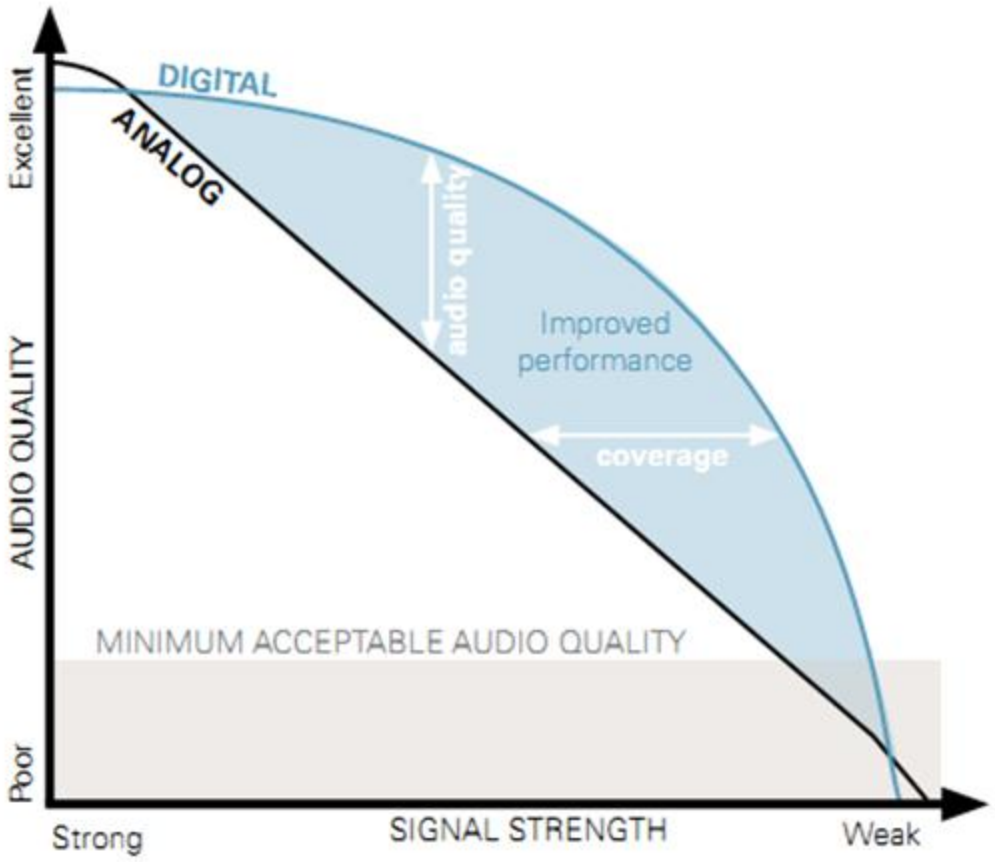
Guard Band as large as 10 kHz between channels

Total BW= 22.5 kHz

No Guard Band between 2 channels

Total BW= 12.5 kHz

Better Signal Quality



Digital voice retains better quality than analog as signal strength decreases.

- No hiss, popping, or static
- Better RF range than older digital technologies
- Forward Error Correction and Cyclic Redundancy Check coders

Better Audio Quality

- Listen for yourself. DMR does sound better than older digital technologies.

Longer Battery Life

Older Digital Modes (FDMA)

DMR (TDMA)

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

“40 percent improvement in talk time in comparison with analogue radios “

http://dmrassociation.org

Data and Voice at the Same Time

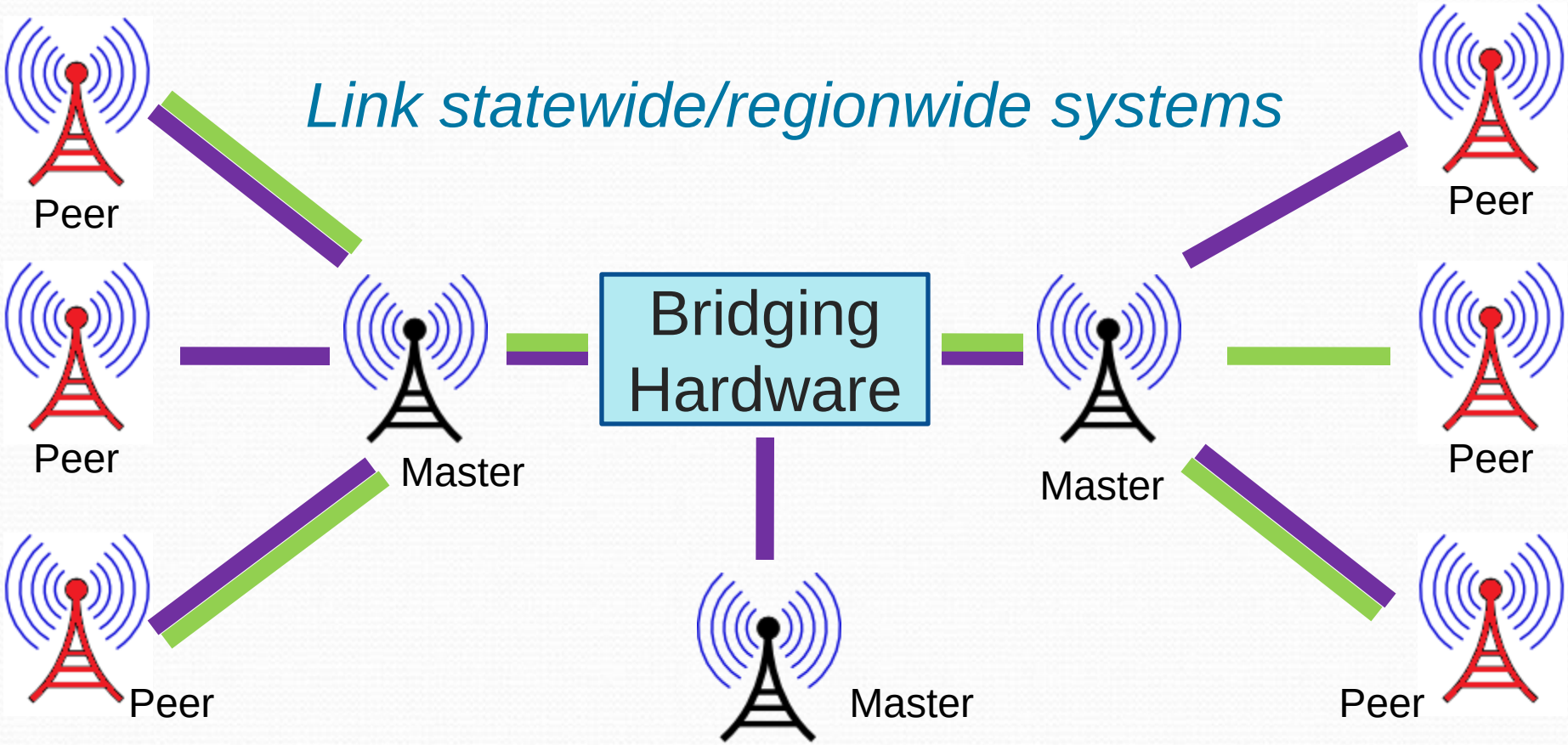
Slot 1 Voice

Slot 2 GPS Location

(or second channel voice when not sending GPS data)

Give your location WHILE talking!

IP Site Connect
1 or 2 slots (channels)



Dynamic Mixed Mode: First in – First Out

Analog

Analog

OR

Slot 1 TDMA

Slot 2 TDMA

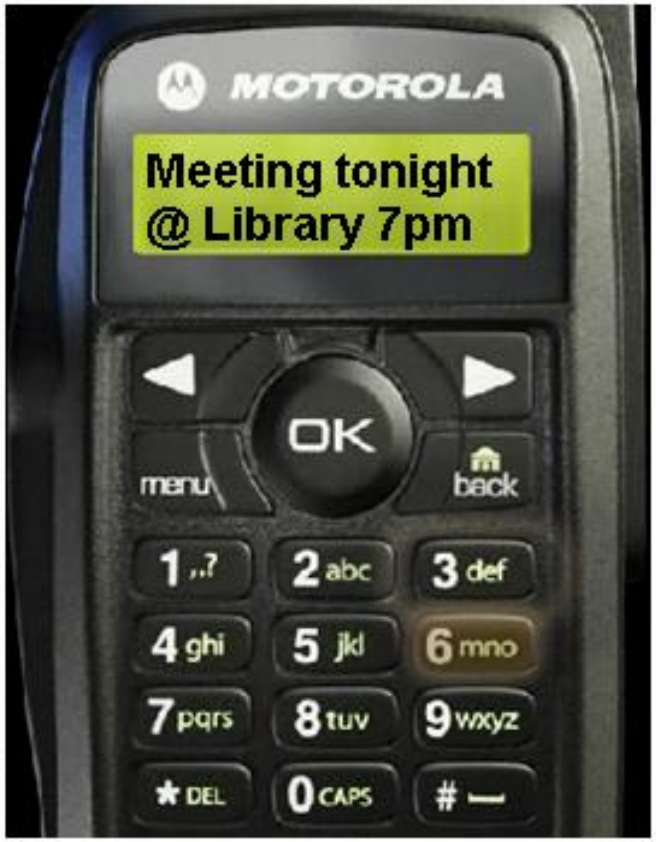
Slot 1 TDMA

Slot 2 TDMA

Repeater dynamically detects the type of input
IP site connect currently not supported in DMM

This is a stand-alone repeater option only.

Free Text Messaging



Send to one person, or a group of people.

- Weather Alerts
- Club Meetings
- Announcements

Monochrome Radios

- XPR6550 and cost reduced XPR3500 portables
- XPR4550 Mobile
- Make sure the radio is UHF1 (403-470 MHz) not 450-512 MHz (commercial band).

New Color Radios Now Available

- XPR7550 Portable
- XPR5550 Mobile
- SL7550 (slim line, looks like cell phone)

DMR Growth

DATE (MM_YY)	# Radio IDs	# Repeaters	DMR-MARC	# Countries
Jan-09	50	6		2
May-10	200	21		3
Feb-11	400	21		3
Sep-11	800	44		6
Dec-11	900	55		8
May-12	1591	152	83	8
Jun-12	1796	164	85	9
Jul-12	1874	169	86	9
Jul-12	1911	175	86	9
Aug-12	1941	178	86	9
Sep-12	2091	188	90	10
Sep-12	2140	191	91	10
Dec-12	2376	211	100	10
Jan-13	2510	230	100	10
Feb-13	2653	245	135	10
Mar-13	2864	265	140	12

DMR-MARC

Motorola Amateur Radio Club Worldwide Network

- Motorola Amateur Radio Clubs and other private XPR8300/8400 and MTR3000 repeater owners
- 160 site network in USA, Germany, Australia, South Africa, New Zealand, Spain, Switzerland, Austria, Canada, Finland, Sweden, Italy, Mexico, and the UK.
- 100% Pure Digital. Voice and text messaging supported.
- Weekly nets to discuss technical issues
- More than 2700 registered users
- To register or learn more http://dmr-marc.net
- There you will also find links to our bridge partners, our Yahoo group and other programming aids.

Talk Groups Increase Capacity!

- Time Slot 1, Talk Group 3 – Native English speakers (USA, Canada, Australia, New Zealand, South Africa, and U.K.)
- Time Slot 1, Talk Group 1 – Primary English language countries to secondary English speaking Europeans
- Time Slot 2, talk group 2 – Local Repeater QSOs.
- Time Slot 2, first 4 digits of state ID (KS = 3120) for statewide linked TS2 systems. Also, country talk groups are 3 digits (Canada = 302)
- Be courteous and use the local time slot for local repeater QSOs and don't monopolize the linked network time slot 1 if you don't have to.

Talk Group Mappings

TG1, TS1(World)

- Saturday Nets
- Calls to second language English speakers
- Don’t use for UK-> USA or Australia-> Canada, etc.

TG3, TS1 (NAm/English)

- Calls to native English speakers
- Share with other users!
- Use local/regional TG/TS when possible

Other Talk Groups

Network	Region	Talk Group ID	Assignment	Notes
DMR-MARC	Europe	1	Intercontinental	TS1 only
DMR-MARC	Europe	2	Europe Continental	TS1
DMR-MARC	Europe	9	Europe Local Repeater	TS2
DMR-MARC	Europe	214	Spain	TS1 or TS2
DMR-MARC	Europe	222	Italy	TS2
DMR-MARC	Europe	228	Switzerland	TS1 or TS2
DMR-MARC	Europe	232	Austria	TS1 or TS2
DMR-MARC	Europe	235	United Kingdom	TS2
DMR-MARC	Europe	240	Sweden	TS1 or TS2
DMR-MARC	Europe	244	Finland	TS1 or TS2
DMR-MARC	Europe	262	Germany	TS1 or TS2
DMR-MARC	N. America, UK, S. Pacific, S. Africa	1	Intercontinental	TS1 only, use only for Sat. nets and calls to Europe
DMR-MARC	N. America, UK, S. Pacific, S. Africa	3	N. America	TS1 only, All English speaking countries
DMR-MARC	S. Pacific	5	Australia/New Zealand Only	TS2
DMR-MARC	N. America	302	Canada	
DMR-MARC	N. America	334	Mexico	TS2
DCI	N. America	3100	DCI Bridge	
GA-DMR	N. America	3113	GA Statewide	TS 2
SF-TRBO	N. America	3115	HI Statewide	TS 2
MIT	N. America	3125	New England Network	TS 2
DCI	N. America	3126	MI Statewide	TS 2
KØUSY Group	N. America	3130	KS Statewide	TS 2
NorCal	N. America	3148	TX Statewide	TS 2
DCI	N. America	3153	WA Statewide	
DCI	N. America	3160	DCI 1	
DCI	N. America	3161	DMR-MARC World	TS2
DCI	N. America	3162	DCI 2	
DCI	N. America	3163	DMR-MARC N. Am.	TS2
DCI	N. America	3166	Test1	
DCI	N. America	3167	Net1	
DCI	N. America	3168	I-5	CA, OR, WA
DMR-MARC	N. America	3170	Midwest USA	TS2
N. Colorado	N. America	3171	N. Colorado	TS2
DMR-MARC	S. Pacific	5054	Queensland	TS 2

ID Scheme

- DMR supports 16777215 IDs. We ask max 2 IDs per person. You can reuse same ID on multiple radios that you use-> Recommended!
- 8-digits: Admin tools and resources
- 7-digits: Subscribers (mobiles and portables)
- 6-digits: Repeaters
- 4-digits: Regional Talk Groups
- 3 digits: Country Talk groups

Examples: Subscriber IDs are 7 digits: XXXYZZZ
where XXX= Country
Y= State/Province
ZZZ= Sequentially assigned subscriber number

Repeater IDs are 6 digits: XXXYWW
where XXX= Country
Y= State/Province
WW= Sequentially assigned repeater number

Common Courtesy

- ALL RADIOS MUST HAVE A VALID 7-DIGIT DMR ID from our website http://dmr-marc.net, Under “Contact Us” Radios without an official ID should not be on the system. Period. Do not make up your own ID.
- Do not key up on TS1 and blow into mic to test your radio. You key up 100+ repeaters and that is annoying to all of us who listen.
- Do radio tests on TS2 with a voice ID.
- You must identify your callsign just like you did in the past on an analog repeater per FCC rules.

Status of C-bridge

- Links master repeaters (groups of 15-20), and bridges
- Mfr: Rayfield Communications Springfield, MO
- We have 6 masters (Chicago, S. NH, S. FL, Montreal, Toronto, and Brisbane), and 14 bridges connected to the DMR-MARC C-bridge and the DMR-MARC-IL C-bridges
- We have connections to multiple bridge partners including DCI (WA), NC-PRN, NorCal, AZ TRBO, WØPM (MO), KØUSY (KS), Georgia DMR, SF TRBO, N2JTI (NJ), N2NSA (NY), N. CO, Denver, Vancouver)

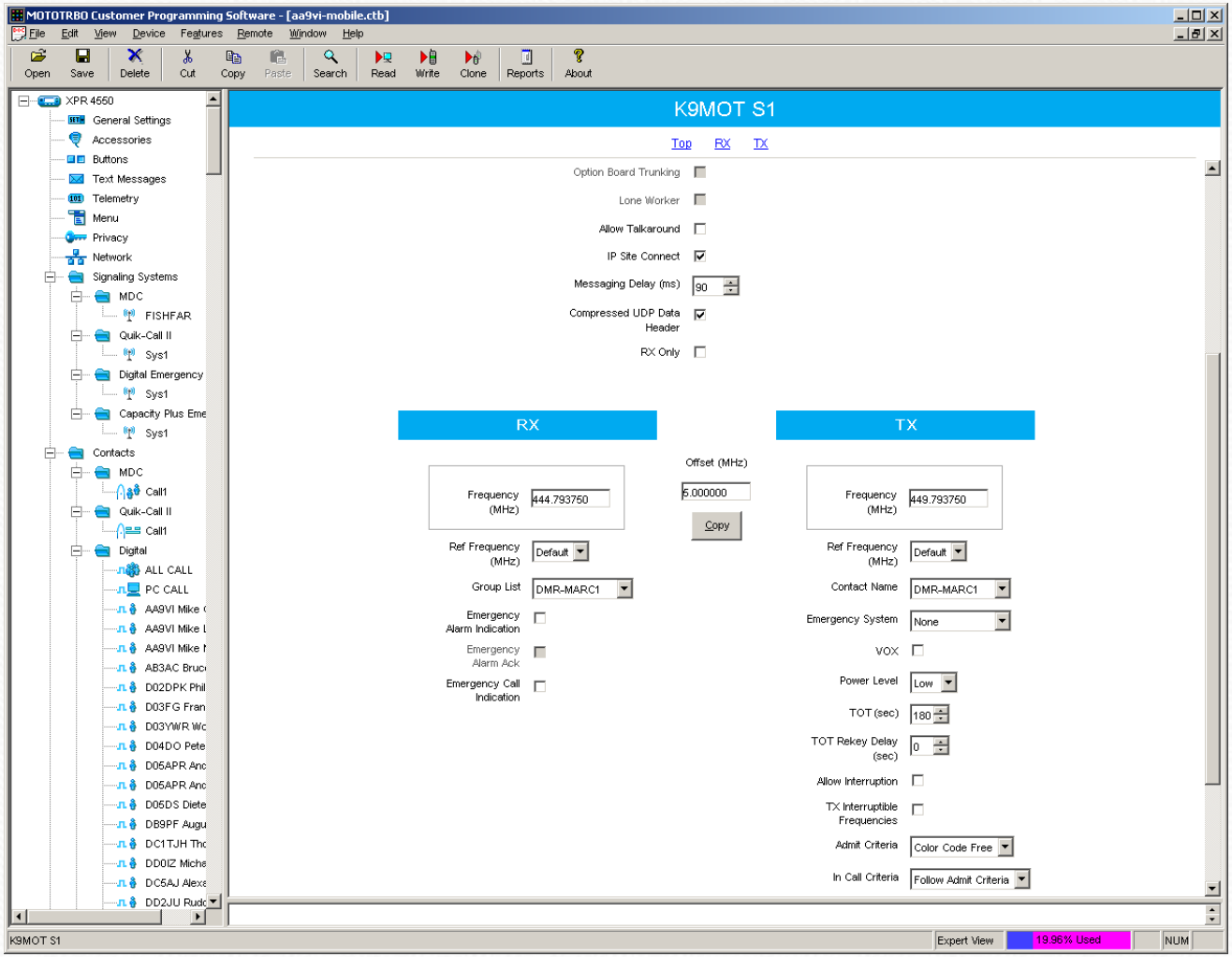
Current Development Projects

- TRBO to APRS-IS. Currently working on FCC ID compliance.
- Automated severe weather warnings to local time slot on radio
- Join our MOTOTRBO Yahoo group to help!

Ham Friendly Dealers

- Rayfield Communications, contact John Rayfield, Jr 800.743.9711. Mention you are part of MARC and inquire about ham pricing.
- Sandy's Communications in Mission Hills, CA
- E-Bay or Local Dealer
- TRBO DMR radios are DMR –and- Analog monoband
- Mobile: XPR4550 UHF band 1 (403-470 MHz) 25-45W, Portable: XPR6550 UHF band 1

Customer Programming SW



C-Bridge Last Heard/Net Status

Firefox

Rayfield Comm

Go to a Website

f times a word is in a document

Most Visited | Getting Started | DRUDGE REPORT | Gmail | Yahoo! Mail | Chicago Sports | Chicagoland Skywarn | AA9VI | QRZ | Chicago AVS Forum | Bookmarks

DMR-MARC
Motorola Amateur Radio Club Worldwide Network

Control Center DMR-MARC

6913.2013.4.22
23:18:31 May 02, 2013
aa9vi | Single connection | Log Out

Home
Config
Connections
Calls
Diagnostics
Net watch
Help

Gateway (1)
DMR-MARC

Total calls
282 Network
331 Local

Network watch Filter: Peer | CC↔CC | Current | Voice Call | Data Call | Destination

Active Peers

W8FSM - Fenton MI	13126203	13129101	0	1262209	13126206					
W4MOT - Plantation FL	311203	13129102	312400	312401	313900	315100	315101	1262204	13124502	13126207
K9MOT - Schaumburg IL	311702	13129103	310804	312606	313100	313202	334301	1262202	13126208	
NE1B - Hudson NH	313300	13129104	312502	313301	313302	313605	1262218	13124503	13126219	
K6EH - Los Angeles CA	310699	13129105	13106203							

CC↔CC

DMR-IL | Bronx-TRBO | DMR-MARC-IL | PRN-Network | AZ-TRBONET | CO-RMHR | NJ-TRBO | GeorgiaDMR | DMR-MARC-IL | DMR-MARC-IL

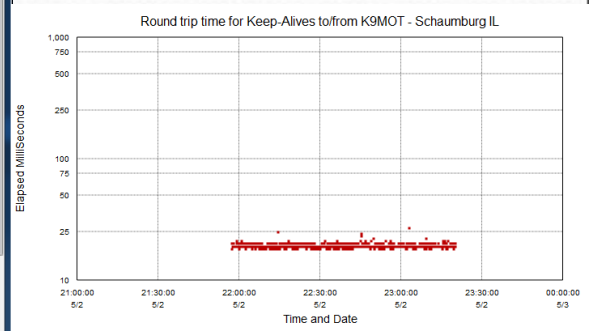
Current Talker

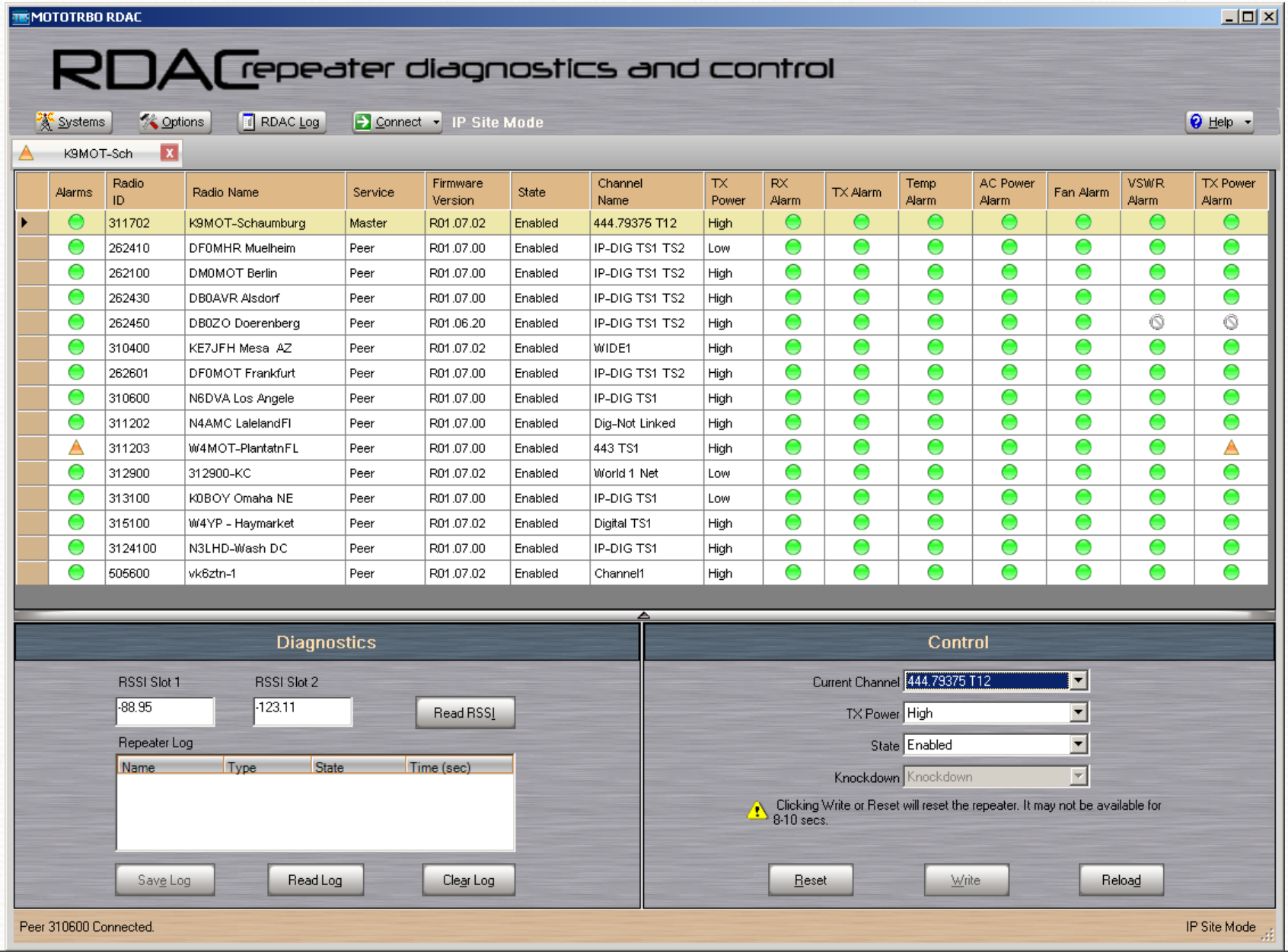
start time	duration	ch	name	source peer id	source radio id	source peer alias	source radio alias	Group ID	RSSI (dBm)	site name

Voice Log

start time	duration	ch	name		source peer id	source radio id	source peer alias	source radio alias	Group ID	RSSI (dBm)	site name
23:15:45.3 May/2	3.8	6	Chicagoland Local	g	313202	3132016	Elko - Nevada - USA -- KB7SJZ	3132016	2353003	-67.9	DMR-MARC
22:52:02.4 May/2	8.5	8	New England Local	g	312502	3125002	Southboro - Massachusetts - USA -- W1EMC	3125002	2353003	-102.3	DMR-MARC
22:47:16.7 May/2	1.6	6	Chicagoland Local	g	334301	0	Cancun - Quintana Roo - Mexico -- XE3RCC	31110		-103.6	DMR-MARC
22:47:09.3 May/2	3.1	6	Chicagoland Local	g	334301	1204	Cancun - Quintana Roo - Mexico -- XE3RCC	1204	111	-100.8	DMR-MARC
22:43:02.7 May/2	0.9	6	Chicagoland Local	g	311702	3117271	Schaumburg - Illinois - USA -- K9MOT	3117271	2353003	-99.3	DMR-MARC
22:39:34.7 May/2	0.5	6	Chicagoland Local	g	311702	3117271	Schaumburg - Illinois - USA -- K9MOT	3117271	2353003	-96.6	DMR-MARC
22:37:09.0 May/2	0.9	5	NA-WW	g	310804	3108097	Denver - Colorado - USA -- W0TX	3108097	2353003	-127.4	DMR-MARC
22:37:05.3 May/2	0.7	5	NA-WW	g	310804	3108097	Denver - Colorado - USA -- W0TX	3108097	2353003		DMR-MARC
22:33:35.0 May/2	4.9	6	Chicagoland Local	g	334301	3343001	Cancun - Quintana Roo - Mexico -- XE3RCC	3343001	111	-80.0	DMR-MARC
22:33:31.7 May/2	0.5	6	Chicagoland Local	g	334301	1202	Cancun - Quintana Roo - Mexico -- XE3RCC	1202	222	-109.1	DMR-MARC
22:33:16.5 May/2	13.8	6	Chicagoland Local	g	334301	1204	Cancun - Quintana Roo - Mexico -- XE3RCC	1204	111	-107.8	DMR-MARC
22:33:16.5 May/2	11.3	6	Chicagoland Local	g	334301	1204	Cancun - Quintana Roo - Mexico -- XE3RCC	1204	111	-81.2	DMR-MARC
22:33:16.5 May/2	5.5	6	Chicagoland Local	g	334301	1204	Cancun - Quintana Roo - Mexico -- XE3RCC	1204	111	-98.2	DMR-MARC
22:33:11.4 May/2	3.8	6	Chicagoland Local	g	334301	3343001	Cancun - Quintana Roo - Mexico -- XE3RCC	3343001	111	-84.4	DMR-MARC
22:32:56.1 May/2	13.9	6	Chicagoland Local	g	334301	1204	Cancun - Quintana Roo - Mexico -- XE3RCC	1204	111	-105.3	DMR-MARC
22:32:50.3 May/2	3.8	6	Chicagoland Local	g	334301	3343001	Cancun - Quintana Roo - Mexico -- XE3RCC	3343001	111	-79.3	DMR-MARC
22:32:51.1 May/2	0.9	6	North America CC - DCI	p	315306	3153011	Seattle - Washington - USA -- NF6C	3153011		-125.6	T6-DCI

Copyright (c) 2004-2012 RavenNet Systems(tm)



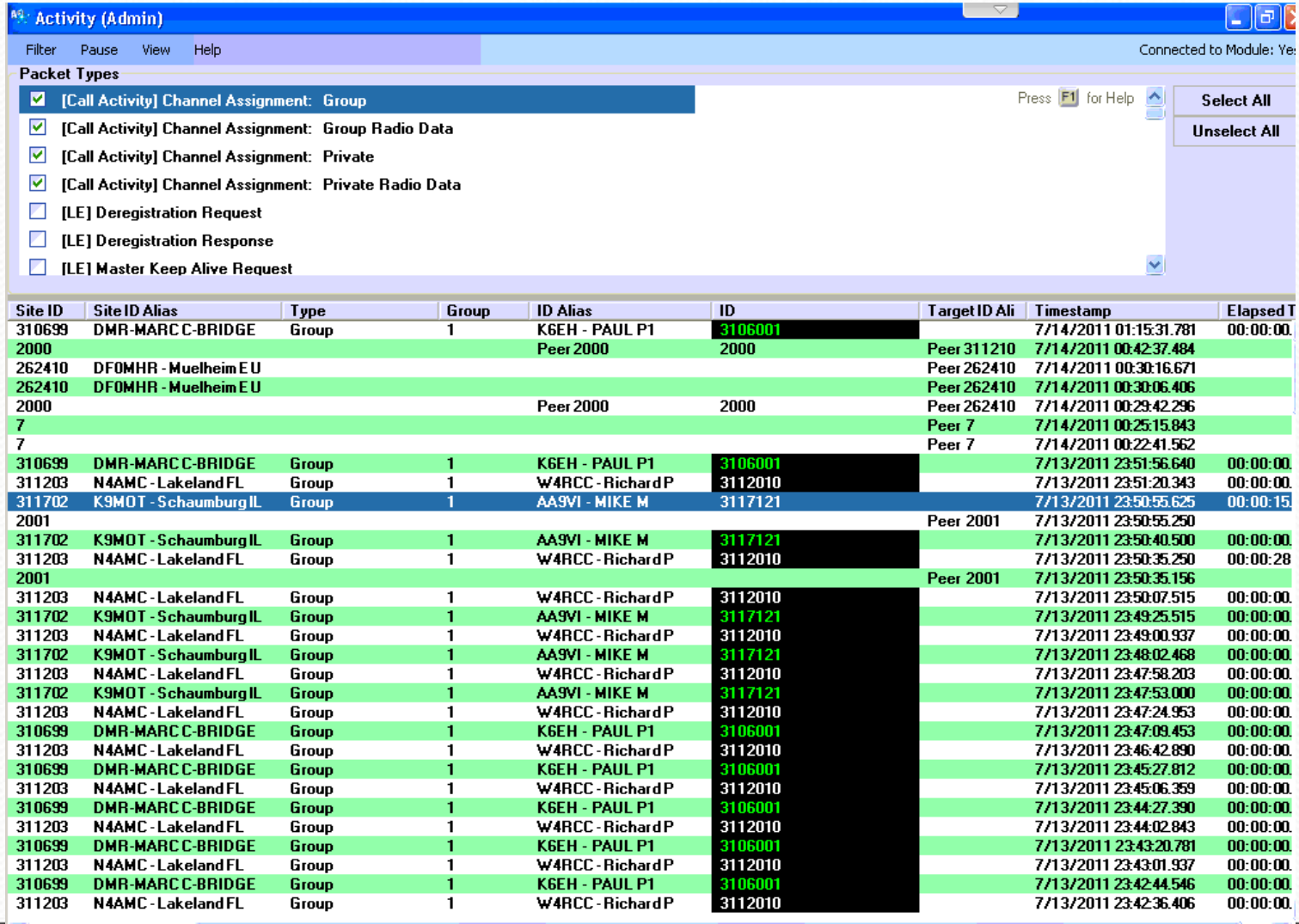

MOTOTRBO RDAC
RDAC repeater diagnostics and control
Systems
Options
RDAC Log
Connect
IP Site Mode
Help
K9MOT-Sch
Alarms
Radio ID
Radio Name
Service
Firmware Version
State
Channel Name
TX Power
RX Alarm
TX Alarm
Temp Alarm
AC Power Alarm
Fan Alarm
VSWR Alarm
TX Power Alarm
311702 K9MOT-Schaumburg Master R01.07.02 Enabled 444.79375 T12 High
262410 DF0MHR Muelheim Peer R01.07.00 Enabled IP-DIG TS1 TS2 Low
262100 DM0MOT Berlin Peer R01.07.00 Enabled IP-DIG TS1 TS2 High
262430 DB0AVR Alsdorf Peer R01.07.00 Enabled IP-DIG TS1 TS2 High
262450 DB0ZO Doerenberg Peer R01.06.20 Enabled IP-DIG TS1 TS2 High
310400 KE7JFH Mesa AZ Peer R01.07.02 Enabled WIDE1 High
262601 DF0MOT Frankfurt Peer R01.07.00 Enabled IP-DIG TS1 TS2 High
310600 N6DVA Los Angele Peer R01.07.00 Enabled IP-DIG TS1 High
311202 N4AMC LalelandFl Peer R01.07.00 Enabled Dig-Not Linked High
311203 W4MOT-PlantatnFL Peer R01.07.00 Enabled 443 TS1 High
312900 312900-KC Peer R01.07.02 Enabled World 1 Net Low
313100 K0BOY Omaha NE Peer R01.07.00 Enabled IP-DIG TS1 Low
315100 W4YP - Haymarket Peer R01.07.02 Enabled Digital TS1 High
3124100 N3LHD-Wash DC Peer R01.07.00 Enabled IP-DIG TS1 High
505600 vk6ztn-1 Peer R01.07.02 Enabled Channel1 High
Diagnostics
RSSI Slot 1
RSSI Slot 2
-88.95
-123.11
Read RSSI
Repeater Log
Name
Type
State
Time (sec)
Save Log
Read Log
Clear Log
Control
Current Channel
444.79375 T12
TX Power
High
State
Enabled
Knockdown
Knockdown
Clicking Write or Reset will reset the repeater. It may not be available for 8-10 secs.
Reset
Write
Reload
Peer 310600 Connected.
IP Site Mode

Acknowledgements

- NE1B and KBØZZT for the DMR Growth Stats
- Rayfield Communications- C-Bridge
- ElComPlus – SmartPTT
- WØWJB – Network Hosting, 2012 Hamvention Booth
- K6EH- Webpage Hosting
- DMR-MARC members for 2013 Hamvention Booth

Backup Slides

GW3TRBO – Who's on Where?



Site ID	Site ID Alias	Type	Group	ID Alias	ID	Target ID Ali	Timestamp	Elapsed T
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/14/2011 01:15:31.781	00:00:00.
2000				Peer 2000	2000	Peer 311210	7/14/2011 00:42:37.484	
262410	DF0MHR - Muelheim E U					Peer 262410	7/14/2011 00:30:16.671	
262410	DF0MHR - Muelheim E U					Peer 262410	7/14/2011 00:30:06.406	
2000				Peer 2000	2000	Peer 262410	7/14/2011 00:29:42.296	
7						Peer 7	7/14/2011 00:25:15.843	
7						Peer 7	7/14/2011 00:22:41.562	
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:51:56.640	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:51:20.343	00:00:00.
311702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121		7/13/2011 23:50:55.625	00:00:15.
2001						Peer 2001	7/13/2011 23:50:55.250	
311702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121		7/13/2011 23:50:40.500	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:50:35.250	00:00:28
2001						Peer 2001	7/13/2011 23:50:35.156	
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:50:07.515	00:00:00.
311702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121		7/13/2011 23:49:25.515	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:49:00.937	00:00:00.
311702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121		7/13/2011 23:48:02.468	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:47:58.203	00:00:00.
311702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121		7/13/2011 23:47:53.000	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:47:24.953	00:00:00.
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:47:09.453	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:46:42.890	00:00:00.
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:45:27.812	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:45:06.359	00:00:00.
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:44:27.390	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:44:02.843	00:00:00.
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:43:20.781	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:43:01.937	00:00:00.
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001		7/13/2011 23:42:44.546	00:00:00.
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010		7/13/2011 23:42:36.406	00:00:00.