

>DMR: THE FUTURE OF TWO-WAY DIGITAL RADIO

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

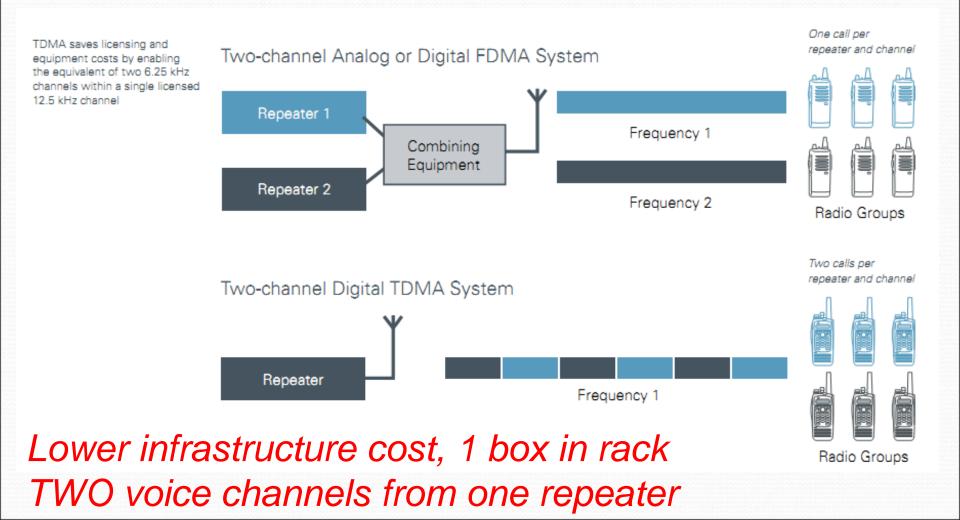




Digital Mobile Radio

- 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!



Half the Channel Bandwidth

 $f_c - 12.5$ f_c $f_c + 12.5$ $f_c - 6.25$ f_c $f_c + 6.25$

Traditional Analog 25 kHz Channel Bandwidth

> 1 Channel 1 Repeater

DMR <u>12.5 kHz</u> Channel Bandwidth

> 2 Channels 1 Repeater

More Spectrum Efficient than Older Digital Modes

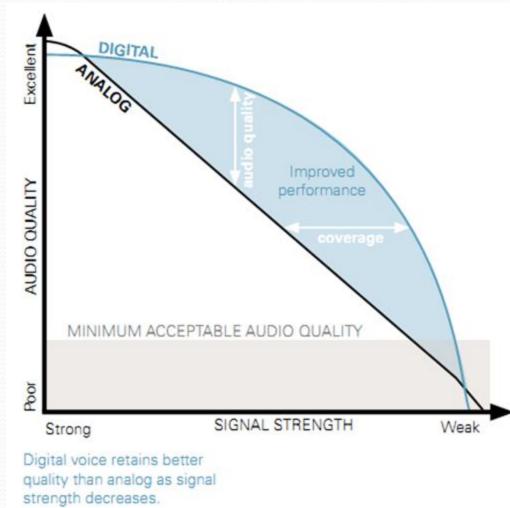
f_c - 6.25

 $f_c - 11.25$ f_c $f_c + 11.25$

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

 $f_c = f_c + 6.25$

Better Signal Quality



- 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 <u>does</u> 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

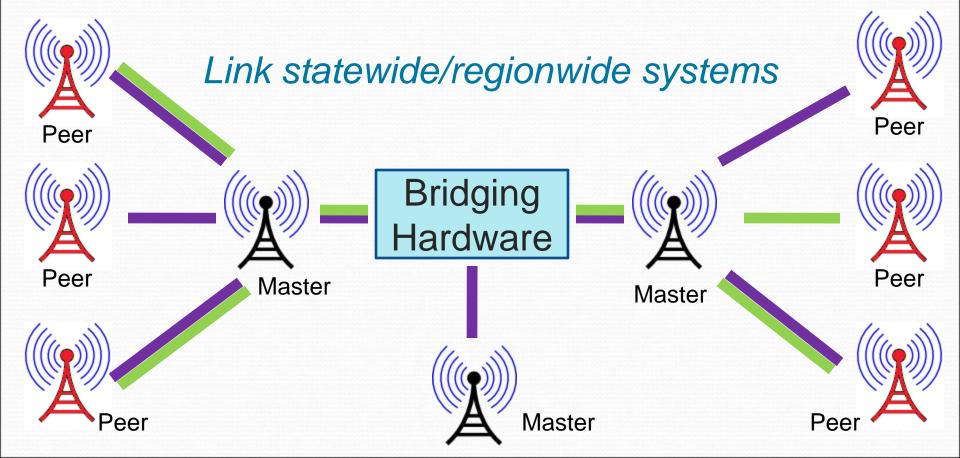
Slot 2 GPS Location

Slot 1 Voice

(or second channel voice when not sending GPS data)

Give your location WHILE talking!

IP Site Connect 1 or 2 slots (channels)



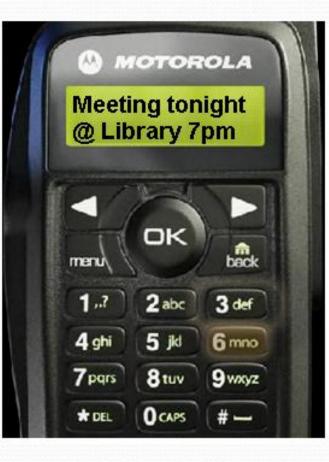
Dynamic Mixed Mode: First in – First Out



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



- 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 <u>http://dmr-marc.net</u>
- 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 Europ
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	1-5	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 <u>you</u> 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 <u>http://dmr-marc.net</u>, 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

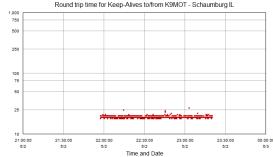
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- 🖂 Text Messages	Option Board Trunking	
III Telemetry	Lone Worker	
	Allow Talkaround	
Privacy	IP Site Connect 🔽	
🖃 – 🔄 Signaling Systems		
📥 💼 мрс	Messaging Delay (ms) go 🐳	
🖳 🕎 FISHFAR	Compressed UDP Data	
🖹 – 🚞 Quik-Call II	Header	
🖳 🕎 Sys1	RX Only	
😑 😑 Digital Emergency		
🖵 🦞 Sys1		
🖻 — 💼 Capacity Plus Eme	RX TX	
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C-Bridge Last Heard/Net Status

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Help ateway (1) MR-MARC otal calls 32 Network	Current Talker Voice	DMR-IL Per start time duration 23:15:45.3 May/2 22:52:02.4 May/2 22:47:09.3 May/2 22:47:09.3 May/2 22:47:09.3 May/2 22:37:09.0 May/2 22:37:05.3 May/2 22:33:31.7 May/2 22:33:31.7 May/2 22:33:16.5 May/2 22:33:16.5 May/2 22:33:16.5 May/2	eh nam duration 3.8 8.5 1.6 3.1 0.9 0.5 0.9 0.7 4.9 0.5 13.8 11.3 5.5	ne F ch 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	source source source source radio id peer d'ardio id peer Chicagoland Lo Chicagol	ocal ocal ocal ocal ocal ocal ocal ocal	source dio alias peeri di g 313202 g 332302 g 334301 g 31702 g 31702 g 31702 g 31702 g 31702 g 310804 g 31804 g 334301 g 334301 g 334301 g 334301 g 334301 g 334301	oup ID R (df source radio id 3132016 3132016 3125002 0 1204 3117271 3108097 3343001 1202 1204 1204	SSI SSI Southborc Cancun - (Cancun - (Schaum Schaum Deny Cancun - (Cancun	st pet o - Nevada - Massach Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R	ource er alias - USA KI usetts - USA oo - Mexico oo - Mexico	B78JZ WIEMC XE3RCC XE3RCC K9MOT W0TX W0TX W0TX XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC	source radio alias 3132016 3125002 31110 1204 3117271 3108097 3108097 3343001 1202 1204 1204 1204	Group ID 2353003 2353003 111 2353003 2353003 2353003 2353003 111 2222 111 111 111	RSSI (dBm) -67.9 -102.3 -103.6 -100.8 -99.3 -99.3 -99.3 -96.6 -127.4 -80.0 -109.1 -107.8 -81.2 -98.2	site name DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI	RC RC RC RC RC RC RC RC RC RC RC RC
Help dateway (1) MR-MARC otal calls 32 Network	Current Talker Voice	DMR-LL Ber start time duration 23:15:45.3 May/2 22:52:02.4 May/2 22:47:16.7 May/2 22:47:09.3 May/2 22:39:34.7 May/2 22:39:34.7 May/2 22:37:09.0 May/2 22:33:35.0 May/2 22:33:35.0 May/2 22:33:16.5 May/2 22:33:16.5 May/2 22:33:16.5 May/2	eh nam duration 3.8 8.5 1.6 0.9 0.5 0.9 0.7 4.9 0.5 13.8 11.3	ne F ch 6 8 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	source source source source radio id peer id radio id peer chicagoland Loc Chicagoland Loc Chicagoland Loc Chicagoland Loc Chicagoland Loc NA-WW NA-WW Chicagoland Loc Chicago	occal oc	source dio alias source peer id g 313202 g 312502 g 312502 g 312502 g 312702 g 311702 g 311702 g 311702 g 311702 g 311702 g 31130804 g 314301 g 334301 g 334301 g 334301	source radio id 3132016 3125002 0 1204 3117271 3117271 3108097 3343001 1202 1204	SSI SSI Sm) eite n: Cancun - (Cancun - (Ca	st per o - Nevada - Massach Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R	ource er alias - USA KI usetts - USA oo - Mexico oo - Mexico	B78JZ WIEMC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC	source radio alias 3132016 3125002 31110 1204 3117271 3108097 3108097 3343001 1202 1204 1204 1204	Group ID 2353003 2353003 111 2353003 2353003 2353003 2353003 111 222 111 111	RSSI (dBm) -67.9 -102.3 -103.6 -100.8 -99.3 -96.6 -127.4 -80.0 -109.1 -109.1 -109.8 -81.2	site name DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI	23 23 25 25 25 25 25 25 25 25 25 25 25 25 25
Net watch Help Gateway (1) MR-MARC otal calls 32 Network 31 Local	Current Talker Voice	DMR-LL Ber start time duration 23:15:45:3 May/2 22:52:02.4 May/2 22:52:02.4 May/2 22:47:16.7 May/2 22:47:09.3 May/2 22:37:09.0 May/2 22:37:09.0 May/2 22:33:0.5 May/2 22:33:16.5 May/2 22:33:16.5 May/2 22:33:11.4 May/2 22:33:11.4 May/2	eh nam duration 3.8 8.5 1.6 3.1 0.9 0.5 0.9 0.7 4.9 0.5 13.8 11.3 5.5 3.8	ne F ch 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	source source source source radio id peer control of the source peer id radio id peer control of the source source control of the source source control of the control of the source control of the control of the source control of the	occal oc	source dio alias source peer id s 313202 g 312202 g 312202 g 312202 g 31202 g 31202 g 311702 g 311702 g 311702 g 311702 g 311702 g 310804 g 334301 g 334301 g 334301 g 334301 g 334301 g 334301	oup ID R (df 3132016 3132016 3125002 0 1204 3117271 3108097 3108097 3343001 1202 1204 1204 1204 1204	SSI SSI Sm) eite n: Cancun - (Cancun - (Ca	si per o - Nevada - Massach Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R Quintana R	ource er alias I- USA KI oo - Mexico oo - Mexico	B78JZ WIEMC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC XE3RCC	source radio alias 3132016 3125002 31110 1204 3117271 3108097 3108097 3343001 1202 1204 1204 1204 1204	Group ID 2353003 2353003 1111 2353003 2353003 2353003 2353003 1112 221111 1111 1111	RSSI (dBm) -67.9 -102.3 -103.6 -100.8 -99.3 -99.3 -96.6 -127.4 -80.0 -109.1 -107.8 -81.2 -98.2 -98.2 -84.4	site name DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI DMR-MAI	23 23 23 23 25 25 25 25 25 25 25 25 25 25 25 25 25

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Δ	кэмо	T-Sch 🛛 🗙	1												
	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
•	0	311702	K9MOT-Schaumburg	Master	R01.07.02	Enabled	444.79375 T12	High		0			0	0	0
	0	262410	DF0MHR Muelheim	Peer	R01.07.00	Enabled	IP-DIG TS1 TS2	Low		0				0	0
	0	262100	DM0MOT Berlin	Peer	R01.07.00	Enabled	IP-DIG TS1 TS2	High	0	0	0	0	0	0	0
	0	262430	DB0AVR Alsdorf	Peer	R01.07.00	Enabled	IP-DIG TS1 TS2	High						0	0
	0	262450	DB0ZO Doerenberg	Peer	R01.06.20	Enabled	IP-DIG TS1 TS2	High						0	Ø
	0	310400	KE7JFH Mesa AZ	Peer	R01.07.02	Enabled	WIDE1	High				۲		0	0
	0	262601	DF0MOT Frankfurt	Peer	R01.07.00	Enabled	IP-DIG TS1 TS2	High				0		0	0
		310600	N6DVA Los Angele	Peer	R01.07.00	Enabled	IP-DIG TS1	High			0	0		0	
	0	311202	N4AMC LalelandFl	Peer	R01.07.00	Enabled	Dig-Not Linked	High	0	0	0	0	0	0	0
		311203	W4MOT-PlantatnFL	Peer	R01.07.00	Enabled	443 TS1	High		0		0		0	<u> </u>
		312900	312900-KC	Peer	R01.07.02	Enabled	World 1 Net	Low				0		0	
		313100	K0BOY Omaha NE	Peer	R01.07.00	Enabled	IP-DIG TS1	Low	0	0	•	0		0	
		315100	W4YP - Haymarket	Peer	R01.07.02	Enabled	Digital TS1	High	0	0	•	0	0	0	0
		3124100	N3LHD-Wash DC	Peer	R01.07.00	Enabled	IP-DIG TS1	High	0	0	0	0	0	0	0
	0	505600	vk6ztn-1	Peer	R01.07.02	Enabled	Channel1	High	0	0	0	0	0	0	0
			Diagn	ostics							Con	trol			
		RSSI Slot	1 RSSI Slot 2							Current Chann	444,7937	5 T12			
		-88.95	-123.11		D. IDCCI										
					Read RSS <u>I</u>					TX Powe	-		•		
		Repeater	-			_				Stat	e Enabled		•		
		Name	Type St	ate	Time (sec)					Knockdow	n Knockdov	vn	T		
								6	N Clicking 8-10 sec	g Write or Rese cs.	et will reset th	e repeater. It m	ay not be ava	ailable for	
		Sav <u>e</u> l	_og Read L	og	Cle <u>a</u> r Log				<u>R</u> es	et	<u> </u>	(rite	Re	eloa <u>d</u>	

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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?

* Activit	y (Admin)						
	Pause View Help					Conn	ected to Module: Y
Packet T							
🗹 [Ca	II Activity] Channel Assign	ment: Group				Press 📶 for Help 📥	Select All
🗹 (Ca	ll Activity] Channel Assign	ment: Group Ra	adio Data			_	Unselect All
🗹 [Ca	II Activity] Channel Assign	ment: Private					
🗹 ICa	II Activity] Channel Assign	ment [.] Private B	adio Data				
] Deregistration Request						
L [LE] Deregistration Response						
🔼 [LE] Master Keep Alive Requ	est				×	
Site ID	Site ID Alias	Туре	Group	ID Alias	ID	Target ID Ali Timestamp	Elapsed
310699	DMR-MARCC-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/14/2011 01:15:31	
000	DFOMHR - Muelheim E U			Peer 2000	2000	Peer 311210 7/14/2011 00:42:37. Peer 262410 7/14/2011 00:30:16	
62410 62410	DFOMHR - Muelheim EU					Peer 262410 7/14/2011 00:30:16 Peer 262410 7/14/2011 00:30:06.	
000	DI UMITTI - MUCHICIIII L U			Peer 2000	2000	Peer 262410 7/14/2011 00:29:42	
				1 001 2000	2000	Peer 7 7/14/2011 00:25:15.	
,						Peer 7 7/14/2011 00:22:41.	562
810699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/13/2011 23:51:56.	640 00:00:0
11203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:51:20	
11702	K9MOT-SchaumburgIL	Group	1	AA9VI - MIKE M	3117121	7/13/2011 23:50:55	
2001			-		0117101	Peer 2001 7/13/2011 23:50:55.	
311702 311203	K9MOT - Schaumburg IL N4AMC - Lakeland FL	Group Group	1	AA9VI - MIKE M W4RCC - Richard P	3117121 3112010	7/13/2011 23:50:40. 7/13/2011 23:50:35.	
2001	NAAMU-LAKCIANUFL	aroup	•	WANCE - NICHALUF	3112010	Peer 2001 7/13/2011 23:50:30	
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:50:07.	
11702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121	7/13/2011 23:49:25	
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:49:00.	937 00:00:0
811702	K9MOT-SchaumburgIL	Group	1	AA9VI - MIKE M	3117121	7/13/2011 23:48:02	
11203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:47:58	
11702	K9MOT - Schaumburg IL	Group	1	AA9VI - MIKE M	3117121	7/13/2011 23:47:53	
311203 310699	N4AMC - Lakeland FL DMR-MARC C-BRIDGE	Group Group	1	W4RCC - Richard P K6EH - PAUL P1	3112010 3106001	7/13/2011 23:47:24. 7/13/2011 23:47:09.	
11203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:46:42	
10699	DMR-MARCC-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/13/2011 23:45:27.	
11203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:45:06.	
10699	DMR-MARCC-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/13/2011 23:44:27.	
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:44:02	
10699	DMR-MARCC-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/13/2011 23:43:20	
311203	N4AMC - Lakeland FL	Group	1	W4RCC - Richard P	3112010	7/13/2011 23:43:01.	937 00:00:0
310699	DMR-MARC C-BRIDGE	Group	1	K6EH - PAUL P1	3106001	7/13/2011 23:42:44	546 00:00:0