

DMR 201 – DMR Linking, the cBridge and DMR Gateways

For RMHAM University December 9, 2023

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THE POWER OF CHEESE

A CHRISTMAS COMMERCIAL FROM CIRCA 1990



WHAT IS THE POWER OF CHEESE?

AGOOGLE SEARCH FOR THE POWER OF CHEESE

- CHEESE IS ALREADY A POWERFUL WAY TO DELIVER
 ESSENTIAL NUTRIENTS
- MANY CONSUMERS ARE SEEKING CLEANER LABELS
 AND MINIMAL INGREDIENTS
- THERE ARE MANY VARIETIES OF CHEESE
- CHEESE FOR THOSE THAT ARE LACTOSE INTOLERANT

GOOGLE FAILED TO ANSWER THE QUESTION! ③



MY DEFINITION OF - THE POWER OF OUR CHEESE?

EMBRACE NEW IDEAS AND CONCEPTS

- THINK OUT OF THE BOX
- DARE TO BE DIFFERENT

- CREATE SOLUTIONS THAT PEOPLE NEED AND HAVE A
 PURPOSE
- BUILD STUFF THAT PEOPLE WILL ENJOY
- HAVE FUN!
- FOCUS ON SERVING OUR COMMUNITY

MOST IMPORTANT! ENJOY THE RIDE ... ENJOY THE CHEESE



IT'S NOT WHAT WE DID. IT'S WHY WE DID IT!

LET'S LOOK BACK TO 1990

- MUCH OF OUR TECHNOLOGY WAS ANALOG BASED
- CONNECTING REPEATERS WAS DIFFICULT AND COMPLICATED
- LIMITED INTEROPERABILITY BETWEEN OUR REPEATERS
- NO REMOTE DIAGNOSTICS



In the 1990s – No cheese. 😕

IT'S NOT WHAT WE DID. IT'S WHY WE DID IT!





TO 2020 ... AND BEYOND

- WE DELIVER BROADBAND TO MOST OF OUR REPEATER SITES AND OPERATING LOCATIONS
- ROBUST REMOTE DIAGNOSTICS
- DIGITAL VOICE IS EASY TO LINK
- COMMUNICATION TECHNOLOGY WE
 DREAMED ABOUT IN 1990

We now have the cheese! Bring out the Charcuterie Board!

IP BACKBONE / MICROWAVE

- FIRST IMPLEMENTED BY RMHAM
- THEN OTHER CLUBS JOINED IN NCARC, CRA, ARA, LARC, FUN MACHINES
- IT'S NOW A GROUP EFFORT

- WE CAN GO TO THE REPEATER SITE WITHOUT GOING TO THE REPEATER SITE
- SUPPORTS ANALOG AND DIGITAL REPEATER LINKING
- EXTENDS TO FIELD DAY, WWV SPECIAL EVENTS, ARES DEPLOYMENTS AND MORE



A SIMPLIFIED (AND SLIGHTLY OLD) NETWORK MAP

- EVERY SITE HAS AN IP ADDRESS BLOCK OR SUB-NET
- EXAMPLE:
 - LEE HILL: 10.30.10.0/24
 - THORODIN: 10.30.20.0/24
 - SQUAW MT: 10.30.30.0/24
 - DURANGO: 10.30.28.0/24
 - QRV2: 10.30.251.0/24
- WE JUST SEND IP PACKETS FROM POINT-A TO POINT-B
- IS IT REALLY THAT EASY?

WELL, NO.



DMR TECHNOLOGY

- WE KNOW THAT ANALOG REPEATERS OPERATE WITH ONE VOICE PATH IN A 16 KHZ OCCUPIED BANDWIDTH CHANNEL
- AS WE LEARNED IN DMR-101 CLASS, DMR TECHNOLOGY HAS TWO VOICE PATHS IN A 12.5 KHZ BANDWIDTH CHANNEL
- DMR IS TIME DIVISION MULTIPLE ACCESS



12.5kHz Analogue 1 voice for each 12.5kHz channel 1 repeater for each channel

12.5kHzTDMA

Divides existing channel into two timeslots Delivers **twice** the capacity through repeater Performance is same or better than 12.5kHz analogue 1 repeater does work of 2 Reduces need for combining equipment Enables 40% increase in radio battery life

DMR REPEATERS

- RMHAM USES MOTOROLA SOLUTIONS REPEATERS IN OUR DMR NETWORK
- CURRENTLY 40 REPEATERS STRONG ON VHF AND UHF ...
 AND GROWING
- SLR5700 REPEATER @ 50 WATTS
- MTR3000 REPEATER @ 100 WATTS
- DMR IS THE RADIO ACCESS PROTOCOL
- MOTOROLA IP SITE CONNECT (IPSC) IS THE LINKING
 PROTOCOL
- BUILT IN NETWORKING OR LINKING USING ETHERNET PORT ON REPEATER
- EACH REPEATER HAS AN IP ADDRESS







IP SITE CONNECT AND THE RMHAM CBRIDGE

"PAY NO ATTENTION TO THAT MAN BEHIND THE CURTAIN!"



WHAT DO I NEED TO KNOW ABOUT IPSC? WHY DO I NEED TO KNOW ABOUT IPSC?

- AS A NETWORK PLANNER, YOU MUST KNOW EVERYTHING!
- AS A USER OR OPERATOR, YOU ONLY NEED TO KNOW A FEW THINGS
- A SINGLE IPSC (A BASIC GROUPING OF REPEATERS) IS LIMITED TO ABOUT 15 REPEATERS
- LINKING MORE THAN 15 REPEATERS REQUIRES MULTIPLE IPSC AND A CBRIDGE
- IP CONNECTIONS FROM OUR RMHAM MICROWAVE BACKBONE
 TRANSPORTS THE DMR SIGNAL FROM SITE TO SITE
- LINKING IS EASY!

Remember the cheese? Behold the power of cheese!

IP SITE CONNECT (IPSC) CONFIGURATION

A sample of some (just four) of our IPSC networks

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horsetod	oth UHF Akro	on UHF	CheyWy UH						
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (Squ	law) UHF	Badger UHF	Brecke	nridge UHF	Vail UHF	Mosquito UHF	Burli	ngton UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3												
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UHF	Salida UHF	Cedarwood	JUHF								

- In this illustration,
 - the first repeater in each IPSC is the MASTER repeater
 - Subsequent repeaters in each IPSC are PEER repeaters
- The MASTER repeater is responsible to collect and distribute the IP routing information for each repeater in the IPSC
- When a DMR voice or data call is established, the source repeater establishes a direct IP connection (using the IP address) to all other repeaters in the IPSC

A sample hypothetical routing table

Repeater	Туре	IP	Timeslots
Buckhorn	MASTER	10.16.8.10	TS1 TS2
cBridge 1	PEER	10.30.20.30	TS1 TS2
Ft Morgan	PEER	10.30.21.10	TS1 TS2
Eldorado	PEER	10.30.80.10	TS1 TS2
Horsetooth S	PEER	10.30.44.10	TS1 TS2
Akron	PEER	10.30.24.10	TS2
Cheyenne WY	PEER	10.30.85.10	TS1

A SAMPLE CALL ON MT THORODIN - CENTRAL (TG 720)

• Mt Thorodin is part of the RMHAM Central IP Site Connect

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horsetod	oth UHF Akr	on UHF	CheyWy UH	IF				
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (Sc	uaw) UHF	Badger UHF	Brecker	nridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3											
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UHF	Salida UHF	Cedarwood	d UHF							
RMHAM Four Corners	Farmington UH	CBridge 5	5 Durango UHF										

We now place a call on Mt Thorodin, TG 720, TS2

- Thorodin is locally repeating the DMR voice call using the repeater receiver and transmitter
- Thorodin is sending ten (10) parallel IPSC streams to the other repeaters in the IPSC
 - Each IP voice data stream is about 50 kbps
- Important Note:
 - All repeaters on a IPSC operate together as one
 - Whatever talk group used on the source repeater is sent to all repeaters on that IPSC
 - Think of this as a DMR version of the Rockettes

But is the call only on the RMHAM Central IPSC repeaters?



A SAMPLE CALL ON MT THORODIN – CENTRAL (TG 720)

• Mt Thorodin is part of the RMHAM Central IP Site Connect

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horseto	oth UHF Akro	on UHF CheyWy UH	łF				
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (Squ	uaw) UHF	Badger UHF	Breckenridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3										
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UHF	Salida UHF	Cedarwoo	d UHF						
RMHAM Four Corners	Farmington UHF	CBridge §	5 Durango UHF									

• But Central (TG720) spans multiple IP Site Connects

RMHAM Northern	Buckhorn UHF CBridge 1 Fort Morgan UHF Eldorado UHF Horsetooth UHF Akron UHF CheyWy UHF
RMHAM Central	Thorodin UHF CBridge 2 Montrose UHF Mestaaehehe (Squaw) UHF Badger UHF Breckenridge UHF Vail UHF Mosquito UHF Burlington UHF Grand Junction UHF Limon A UHF
RMHAM Fremont Peak	Fremont UHF CBridge 3
RMHAM Southern	Almagre UHF CBridge 4 ChevenneMtn UHF Salida UHF Cedarwood UHF
RMHAM Four Corners	Farmington UHF CBridge 5 Durango UHF
RMHAM Lookout UHF	Lookout UHF CBridge 6
RMHAM Pajarito NM UHF	Pajarito UHF CBridge 8
RMHAM Sandia Crest UHF	Sandia UHF CBridge 9
RMHAM Westcreek UHF	Westcreek UHF CBridge 10
RMHAM Devils Head UHF	Devilshead UHF CBridge 11
RMHAM Picuris UHF	Picuris UHF CBridge 13
Boulder Local	Boulder Local CBridge 14
RMHAM FtCol CSU UHF	CSU UHF CBridge 15
RMHAM Rangely UHF	Rangely UHF CBridge 16
EOSS Portable 1	EOSS 1 UHF CBridge 17
EOSS Portable 2	EOSS VAN UHF CBridge 18
Limon-B	Limon B UHF CBridge 19
RMHAM QRV2 UHF	0 CBridge 20
RMHAM QRV2 VHF	0 CBridge 21
W0VG SOW1	0 CBridge23
RMHAM Almagre VHF	Almagre VHF CBridge 25
RMHAM Squaw VHF	Mestaaehehe (Squaw) VHF CBridge 26
RMHAM Lookout VHF	Lookout VHF CBridge 27
RMHAM Buckhorn VHF	Buckhorn VHF CBridge 28
NM0TH Home Test Repeater UHF	54124
NM0TH Home Test Repeater VHF	54126

The cBridge routes the DMR call to multiple IP Site Connect systems within RMHAM

- RMHAM Central (10 repeaters)
- Lookout Mountain UHF
- Westcreek UHF
- Rangely UHF
- Lookout Mountain VHF
- Multiple QRV vans operating portable

19 total repeaters?!?!

How does the call bridge across multiple IP Site Connect (IPSC) systems ?

WHAT'S HAPPENING WITHIN THE CBRIDGE?

• A SAMPLE OF SOME (JUST FIVE) OF OUR IPSC NETWORKS (THIS CALL IS ON TG700)

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horseto	oth UHF Akro	on UHF CheyWy U	HF				
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (So	quaw) UHF	Badger UHF	Breckenridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3										
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UH	F Salida UHF	Cedarwoo	d UHF						
RMHAM Four Corners	Farmington UH	CBridge 8	5 Durango UHF									

- The DMR voice call is bridged to the other IPSCs in our network using the cBridge
- This happens using Bridge Groups



BRIDGE GROUPS - A SIMPLIFIED VIEW

OUR CBRIDGE USES BRIDGE GROUPS TO LINK MULTIPLE IPSC NETWORKS TOGETHER

• WE IDENTIFY EVERY "LINK ID" THAT HAS THE APPROPRIATE TALK GROUP (TG), AND TIE THEM TOGETHER IN A "BRIDGE GROUP"



THE RESULT IS THE BRIDGE GROUP ROUTING TABLE SHOWN
 TO THE RIGHT

Manage Bridge Groups on CO-RMHR

		Connec	tion t	ype	Brid	ge Grou	ips	5	Site n	ame	Lin	k ID	Grou	ıp ID
al				~	Central T	G720	~	all		~	all	~	all	~
		Bridg	e Gro	oup ?	Sit	e Name	?	Lir ID	ık 👔	Alert on Absent	?	Group	D ID 1	
	Ce	ntral TG	720		CO-RMH	R		4			2	720		
.P.S	.c.	Add Er	ntry	Delete Entr	Modify	y Entry	Delete T C	'his l onfi	Bridg rm [e Group	Del	ete TI Con	his Gro firm [oup ID
		edit	Cor	utrol Center	Inbound	Centra	al TG720	U	S-BM	-3103	72	silend	ce	
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	4	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	12	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	14	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	20	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	32	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	34	silence	720)		
/			edit	I.P.S.C.	Central T	G720	CO-RM	HR	36	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	40	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	42	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	44	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	46	silence	720)		
			edit	I.P.S.C.	Central T	G720	CO-RM	HR	54	silence	720)		

BRIDGE GROUPS CONFIGURATION - THE BIG PICTURE

P.S.C. Manager	1	Time Slot 1		Time Slot 2		
RMHAM Northern	0 1 Reg. peers (6)	RMHAM Northern TS1 TG700	Link ID #1	RMHAM Northern TS2 TG721	Link ID #2	
RMHAM Central	2 Reg. peers (10)	RMHAM Central TS1 TG700	Link ID #3	RMHAM Central TS2 TG720	OLink ID #4	
RMHAM Fremont Peak	🔍 3 Reg.	RMHAM Fremont TS1 TG700	Cink ID #5	RMHAM TS2 South-Central-North	Link ID #6	
RMHAM Southern	4 Reg. peers (4)	RMHAM Southern TS1 TG700	Link ID #7	RMHAM Southern TS2 TG719	Link ID #8	
RMHAM Four Corners	5 Reg. peers (2)	RMHAM FourCorners TS1 TG700	Link ID #9	RMHAM FourCorners TS2 TG745	Link ID #10	
RMHAM Lookout UHF	0 Reg.	RMHAM Lookout UHF TS1 TG710	Link ID #11	RMHAM Lookout UHF TS2 TG720	OLink ID #12	
Unused	7 Silent	Unused	Link ID #13	Unused	Link ID #14	
RMHAM Pajarito NM UHF	🔎 8 Reg.	RMHAM Pajarito TS1 TG700	Link ID #15	RMHAM Pajarito TS2 TG719 TG505 TG714	Link ID #16	
RMHAM Sandia Crest UHF	9 Reg.	RMHAM Sandia TS1 TG700	Link ID #17	RMHAM Sandia TS2 TG719 TG505 TG713	Link ID #18	
RMHAM Westcreek UHF	010 Reg.	RMHAM Westcreek TS1 TG700	Link ID #19	RMHAM Westcreek TS2 TG720	Link ID #20	
RMHAM Devils Head UHF	011 Reg.	RMHAM Devils Head TS1 TG719	Link ID #21	RMHAM Devils Head TS2 TG711	Link ID #22	
Unused	12 Silent	Radio + IP I.P.S.C. 23	Link ID #23	Radio + IP I.P.S.C. 24	Link ID #24	
RMHAM Picuris UHF	013 Reg.	RMHAM Picuris TS1 TG700	Link ID #25	RMHAM Picuris TS2 TG505 TG715 TG719	OLink ID #26	
Boulder Local	014 Reg.	Eastern TS1 TG705	Link ID #27	Boulder Local TS2 TG723	Link ID #28	
RMHAM FtCol CSU UHF	015 Reg.	RMHAM FtCol CSU TS1 TG722	Link ID #29	RMHAM FtCol CSU TS2 TG721	Link ID #30	
RMHAM Rangely UHF	●16 Reg.	RMHAM Cathedral TS1 TG700	Link ID #31	RMHAM Cathedral TS2 TG720	Link ID #32	
EOSS Portable 1	17 ??	EOSS Portable 1 TS1 TG700	Link ID #33	EOSS Portable 1 TS2 TG719 720 721	Link ID #34	
EOSS Portable 2	●18 Reg.	EOSS Portable 2 TS1 TG700	Link ID #35	EOSS Portable 2 TS2 TG719 720 721	Link ID #36	
Limon-B	0 19 Reg.	RMHAM Northern TS1 TG721	Link ID #37	RMHAM Northern TS2 TG719	OLink ID #38	
RMHAM QRV2 UHF	20 ??	RMHAM QRV2 UHF TS1 TG700	Link ID #39	RMHAM QRV2 UHF TS2 Regional	Link ID #40	
RMHAM QRV2 VHF	21 ??	RMHAM QRV2 VHF TS1 TG700	Link ID #41	RMHAM QRV2 VHF TS2 TG705	Link ID #42	
AUXCOM SOW1	22 Silent	AUXCOMM SOW1 TS1 TG700	Link ID #43	AUXCOMM SOW1 TS2 TG720	Cink ID #44	
W0VG SOW1	23 ??	W0VG SOW1 TS1 TG700	Link ID #45	W0VG SOW1 TS2 TG720	Link ID #46	
RMHAM Conifer VHF	24 Silent	RMHAM Conifer VHF TS1 TG700	Link ID #47	RMHAM Conifer VHF TS2 TG705	Link ID #48	
RMHAM Almagre VHF	25 Reg.	RMHAM Almagre VHF TS1 TG700	Link ID #49	RMHAM Almagre VHF TS2 TG705	Link ID #50	
RMHAM Squaw VHF	2 6 Reg.	RMHAM Squaw VHF TS1 TG700	Link ID #51	RMHAM Squaw VHF TS2 TG705	Link ID #52	
RMHAM Lookout VHF	2 7 Reg.	RMHAM Lookout VHF TS1 TG700	Link ID #53	RMHAM Lookout VHF TS2 TG720	Link ID #54	
RMHAM Buckhorn VHF	2 8 Reg.	RMHAM Buckhorn VHF TS1 TG700	Link ID #55	RMHAM Buckhorn VHF TS2 TG705	Link ID #56	
WyDMR Thermopolis	29 Silent	WyDMR Wyoming Wide TS1 TG3156	Link ID #57	WyDMR Local TS2 TG100	Link ID #58	
NM0TH Home Test Repeater UHF	OMaster	Radio + IP I.P.S.C. 59	Link ID #59	Radio + IP I.P.S.C. 60	Link ID #60	
NM0TH Home Test Repeater VHF	◯31 Master	Radio + IP I.P.S.C. 61	Link ID #61	Radio + IP I.P.S.C. 62	Link ID #62	
Manager For I.P.S.C. 63 + 64	32 Silent	Radio + IP I.P.S.C. 63	Link ID #63	Radio + IP I.P.S.C. 64	Cink ID #64	
Manager For I.P.S.C. 65 + 66	33 Silent	Radio + IP I.P.S.C. 65	Link ID #65	Radio + IP I.P.S.C. 66	Link ID #66	
Brandmeister to 700	34 Silent	US-BM-3103 TG310800 - TG700	Link ID #67	Radio + IP I.P.S.C. 68	Link ID #68	
Brandmeister to 719	2 35 ??	Radio + IP I.P.S.C. 69	Link ID #69	US-BM-3103 719	Link ID #70	
Brandmeister to 720	10 36 ??	Radio + IP I.P.S.C. 71	Link ID #71	US-BM-3103 720	Link ID #72	
Brandmeister to 721	27 ??	Radio + IP I.P.S.C. 73	Link ID #73	US-BM-3103 721	Link ID #74	
WyDMR Cheyenne	38 Silent	WyDMR Wyoming Wide TS1 TG3156	Link ID #75	WyDMR Local TS2 TG100	Link ID #76	

Manage Bridge Groups on CO-RMHR

Connection type	Bridge Grou	ıps	Site n	ame	Link ID	Group ID
all v	Central TG720	~	all	~	all v	all v
Bridge Group 🔋	Site Name	2	Link ID	Alert on Absent	? Gro	up ID 🔋
Central TG720	C <mark>O-RI</mark> MHR		4		720	
P.S.C. Add Entry Delete Ent	ry Modify Entry	Delete T C	his Bridg onfirm 🗌	e Group	Delete Co	This Group ID nfirm 🗌
edit Control Center	Inbound Centra	al TG720	US-BM	I-3103	72 sile	nce
edit I.P.S.C.	Central TG720	CO-RMI	IR 4	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 12	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 14	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 20	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 32	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 34	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 36	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	HR 40	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 42	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 44	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	IR 46	silence	720	
edit I.P.S.C.	Central TG720	CO-RMI	łR 54	silence	720	

A SAMPLE CALL ON MT THORODIN - CENTRAL (TC 720) UNDEFINED TG 777

• Mt Thorodin is part of the RMHAM Central IP Site Connect

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horsetod	oth UHF Akro	n UHF CheyWy Uł	łF				
RMHAM C	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (Sq	uaw) UHF	Badger UHF	Breckenridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Frem	Fremont UHF	CBridge 3										
RMH S	Almagre UHF	CBridge 4	CheyenneMtn UHF	Salida UHF	Cedarwood	d UHF						
	Farmington UHF	CBridge 5	Durango UHF									

C 1 of Central (TG720) spans multiple IP Site Connects

2.

RMHAM Lookout VHF

RMHAM Buckhorn VHF

MOTH Home Test Repeater UHF

NM0TH Home Test Repeater VHF 54126

Lookout VHF

54124

Buckhorn VHF

CBridge 27

CBridge 28

1	RMHAM Northern	Buckhorn UHF CBridge 1 Fort Morgan UHF Eldorado UHF Horsetooth UHF Akron UHF CheyWy UHF
	RMHAM Central	Thorodin UHF CBridge 2 Montrose UHF Mestaehehe (Squaw) UHF Badger UHF Breckenridge UHF Vall UHF Mosquito UHF Burlington UHF Grand Junction UHF Limon A UHF
	RMHAM Fremont Peak	Fremont UHF CBridge 3
ľ	RMHAM Southern	Almagre UHF CBridge 4 ChevenneMtn UHF Salida UHF Cedarwood UHF
	RMHAM Four Corners	Farmington UHF CBridge 5 Durango UHF
ľ	RMHAM Lookout UHF	Lookaut UHF CBridge 6
ľ	RMHAM Pajarito NM UHF	Pajarito UHF CBridge 8
ľ	RMHAM Sandia Crest UHF	Sandia UHF CBridge 9
ľ	RMHAM Westcreek UHF	Westcreek UHF CBridge 10
	RMHAM Devils Head UHF	Devishead UHF CBridge 11
ĺ	RMHAM Picuris UHF	Picuris UHF CBridge 13
	Boulder Local	Boulder Local CBridge 14
ľ	RMHAM FtCol CSU UHF	CSU UHF CBridge 15
	RMHAM Rangely UHF	Rangely UHF CBridge 16
ľ	EOSS Portable 1	EOSTIUME Canada T
	EOSS Portable 2	
ľ	Limon-B	
	RMHAM QRV2 UHF	Ihis example shows a call on the Cent
ľ	RMHAM QRV2 VHF	0 CBridge 21
ľ	W0VG SOW1	<u>Can we initiate a call using TG</u>
	RMHAM Almagre VHF	Almagre VHF CBridge 25
ľ	RMHAM Squaw VHF	

The cBridge routes the DMR call to multiple IP Site Connect systems within RMHAM

- RMHAM Central (10 repeaters)
- Lookout Mountain UHF
- Westcreek UHF
- Rangely UHF
- Lookout Mountain VHF

is example shows a call on the Central IPSC using TG 720 on TS2. Can we initiate a call using TG 777 on Central IPSC on TS2? Will the call on TG 777 be routed to all repeaters? Or just some?

When you have completed the exam please give your test booklet to Prof Willem

A SAMPLE CALL ON MT THORODIN - ROCKY MT (TG 700)

•As with the previous example, Mt Thorodin is part of the RMHAM Central IP Site Connect

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horseto	oth UHF Akro	on UHF	CheyWy UH	IF				
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (Squ	aw) UHF	Badger UHF	Brecken	ridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3											
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UH	F Salida UHF	Cedarwoo	d UHF							
RMHAM Four Corners	Farmington UHF	CBridge 8	5 Durango UHF										

A SAMPLE CALL ON MT THORODIN - ROCKY MT (TG 700)

•As with the previous example, Mt Thorodin is part of the RMHAM Central IP Site Connect

RMHAM Northern	Buckhorn UHF	CBridge 1	Fort Morgan UHF	Eldorado UHF	Horseto	oth UHF Akro	on UHF CheyWy UH	ΗF				
RMHAM Central	Thorodin UHF	CBridge 2	Montrose UHF	Mestaaehehe (So	quaw) UHF	Badger UHF	Breckenridge UHF	Vail UHF	Mosquito UHF	Burlington UHF	Grand Junction UHF	Limon A UHF
RMHAM Fremont Peak	Fremont UHF	CBridge 3										
RMHAM Southern	Almagre UHF	CBridge 4	CheyenneMtn UH	F Salida UHF	Cedarwoo	d UHF						
RMHAM Four Corners	Farmington UHF	CBridge 8	5 Durango UHF									

• Actual case for Rocky Mt (TG700) spanning multiple IP Site Connects

RMHAM Northern	Buckhorn UHF CBridge 1 Fort Morgan UHF Eldorado UHF Horsetooth UHF Akron UHF CheyWy UHF
RMHAM Central	Thorodin UHF CBridge 2 Montrose UHF Mestaaehehe (Squaw) UHF Badger UHF Breckenridge UHF Vail UHF Mosquito UHF Burlington UHF Grand Junction UHF Limon A UHF
RMHAM Fremont Peak	Fremont UHF CBridge 3
RMHAM Southern	Almagre UHF CBridge 4 CheyenneMtn UHF Salida UHF Cedarwood UHF
RMHAM Four Corners	Farmington UHF CBridge 5 Durango UHF
RMHAM Lookout UHF	Lookout UHF CBridge 6
RMHAM Pajarito NM UHF	Pajarito UHF CBridge 8
RMHAM Sandia Crest UHF	Sandia UHF CBridge 9
RMHAM Westcreek UHF	Westcreek UHF CBridge 10
RMHAM Devils Head UHF	Devilshead UHF CBridge 11
RMHAM Picuris UHF	Picuris UHF CBridge 13
Boulder Local	Boulder Local CBridge 14
RMHAM FtCol CSU UHF	CSU UHF CBridge 15
RMHAM Rangely UHF	Rangely UHF CBridge 16
EOSS Portable 1	EOSS 1 UHF CBridge 17
EOSS Portable 2	EOSS VAN UHF CBridge 18
Limon-B	Limon B UHF CBridge 19
RMHAM QRV2 UHF	0 CBridge 20
RMHAM QRV2 VHF	0 CBridge 21
W0VG SOW1	0 CBridge23
RMHAM Almagre VHF	Almagre VHF CBridge 25
RMHAM Squaw VHF	Mestaaehehe (Squaw) VHF CBridge 26
RMHAM Lookout VHF	Lookout VHF CBridge 27
RMHAM Buckhorn VHF	Buckhorn VHF CBridge 28

The cBridge routes the DMR call to multiple IP Site Connect systems within RMHAM

• 37 DMR repeaters

- 19 cBridge connections
- And more in 2024 with new sites and QRV units



HOW DO I PROGRAM MY RADIO FOR DMR REPEATER USE?

- FIRST, DOWNLOAD A CODE PLUG FROM <u>WWW.RMHAM.ORG</u>
- SECOND, IF YOU WANT TO MODIFY THAT CODE PLUG THEN REFER TO THE RMHAM UNIVERSITY PRESENTATION BY MIKE, KONGA
- IF CREATING YOUR OWN, REFER TO THE INFORMATION ON THE RMHAM WEB SITE
- EXAMPLE FOR CENTRAL TALK GROUP 720

A regional network supporting the Central Colorado area using Talk Group **720**. As a test, this network can be accessed via the Brandmeister via talkgroup 310801. You cannot connect outbound to any other Brandmeister talkgroup by PTTI No Private Calling, Data, Texting or GPS

		a. Repeaters suppor	ang ans aik group a			
Name	Site	Repeater Input	Repeater Output	Color Code	Time Slot	Status
Breckenridge	Baldy	440.0875 MHz	445.0875 MHz	7	2	Operational-Linked
Burlington	Burlington	440.0500 MHz	445.0500 MHz	6	2	Operational-Linked
Denver West UHF	Squaw Mountain	441.9375 MHz	446.9375 MHz	7	2	Operational-Linked
Denver North UHF	Thorodin Mountain	441.8000 MHz	446.8000 MHz	7	2	Operational-Linked
Denver Central UHF	Lookout Mountain UHF	441.8375 MHz	446.8375 MHz	7	2	Operational-Linked
Denver Central VHF	Lookout Mountain VHF	144.7700 MHz	145.3700 MHZ	7	2	REPEATER OFFLINE
Fairplay	Badger Mountain	441.7625 MHz	446.7625 MHz	7	2	Operational-Linked
Grand Junction	Grand Mesa	440.0500 MHz	445.0500 MHz	5	2	Operational-Linked
Leadville	Leadville	440.0500 MHz	445.0500 MHz	7	2	Operational-Linked
Limon	Cedar Point	440.275 MHz	445.275 MHz	7	2	Operational-Linked
Montrose	Waterdog	440.0750 MHz	445.0750 MHz	8	2	Operational-Linked
Rangely	Cathedral Bluffs	440.2625 MHz	445.2625 MHz	7	2	Operational-Linked
Vail	Vail	440.0750 MHz	445.0750 MHz	7	2	Operational-Linked
Westcreek/Doug. Co.	Westcreek	441.8750 MHz	446.8750 MHz	6	2	Operational-Linked

Central Colorado Regional Network - Talk Group 720

Return to Intro



WHAT HAPPENS IF ONE OF THE MICROWAVE LINKS FAIL? (PG 1 OF 2)

WHAT IF THE LINK FAILS AT THE CONTINENTAL DIVIDE?

- TALK GROUP IS CENTRAL TG720
- OUR CENTRAL IP SITE CONNECT WILL FRAGMENT INTO TWO (OR MAYBE MORE) SEGMENTS



WHAT HAPPENS IF ONE OF THE MICROWAVE LINKS FAIL? (PG 2 OF 2)

Sentral - W

WHAT IF THE LINK FAILS AT THE CONTINENTAL DIVIDE?

- TALK GROUP IS CENTRAL TG720
- OUR CENTRAL IP SITE CONNECT WILL FRAGMENT INTO TWO (OR MAYBE MORE) SEGMENTS



THE RESULT

- THE TWO SIDES OF CENTRAL TG 720 ARE FRAGMENTED
- WHAT WAS ONCE A BIG ISLAND OF COVERAGE BECOMES AN
 ARCHIPELAGO
- LOCAL USE ON EITHER SIDE OF THE "BREAK" CONTINUES
- COMMUNICATION FROM "EAST TO WEST" IS NOT POSSIBLE







OTHER NETWORKS



LOTS OF DMR NETWORKS



Show the Inspector S BrandMeister

FROM HTTPS://WIKI.BRANDMEISTER.NETWORK/INDEX.PHP/WHAT_IS_BRANDMEISTER

English / Deutsch / Español / Français / hrvatski / Nederlands

What is BrandMeister?

BrandMaster/BrandMeister is an operating software for Master servers participating in a worldwide infrastructure network of amateur radio digital voice systems.

- If you are an amateur radio operator working in digital voice modes like D-Star, DMR, C4FM, APCO P25 or others (not all are supported yet!!). You do not need to know much
 about BrandMeister, and it's very easy to operate on its infrastructure.
- If you are an amateur radio operator that runs a repeater in your local area, you may be interested in learning some more about BrandMeister and how you can take part in it.

BrandMeister allows me...



"I know what you are thinking." With all of these features why is RMHAM not fully linked to BM?

Contents

WE HAVE LIMITED CONNECTIVITY WITH BRANDMEISTER PROS AND CONS OF BRANDMEISTER (BM)

Show the Inspector S BrandMeister

English / Deutsch / Español / Français / hrvatski / Nederlands

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BrandMeister allows me...

- · To roam automatically from repeater to repeater
- To make private QSOs on any time-slot
- To make world-wide QSOs with any type of amateur DMR network
- To send my location to APRS
- To send and receive SMS messages
- To send and receive SMS messages to or from APRS
- To control some electrical apparatus using my DMR radio as a remote control device

Network Considerations

- BM servers are remote and require Internet connectivity
- RMHAM servers and cBridge is within our microwave network
- RMHAM desires to be Access Technology agnostic
- We are investigating ways to interoperate across analog and digital modes
- Interoperable links require coordination of Talk Groups and Radio Identifiers

PROS

- RMHAM does support DMR site roaming
- RMHAM does support interoperability using our Regional Groups to BM

CONS

- Private calls dedicate a shared resource to a small set of users. This is confusing to the most casual of observer.
- Automatic transmission of GPS information, remote control of devices or SMS is not identified as per FCC rules and thus not compliant with Part 97.

RMHAM DMR is a purpose built network that uses non-Internet links whenever possible.

RMHAM supported

RMHAM NOT supported

RMHAM partial support

RMHAM NOT supported

RMHAM NOT supported

RMHAM NOT supported

Brandmeister is Internet based using remote servers.

RMHAM SUPPORT FOR BRANDMEISTER

- RMHAM HAS SOME LIMITED CONNECTIVITY TO OUTSIDE NETWORKS - SPECIFICALLY BRANDMEISTER
- TALK GROUPS ARE LIMITED TO THE RMHAM REGIONAL NETWORKS
- RMHAM TALK GROUPS ARE NOT DIRECTLY SUPPORTED ON BRANDMEISTER – THUS WE NEED TO TO TRANSLATE
- PROVIDES INTEROPERABILITY WITH HOT SPOTS
- AN OFFICIAL RADIOID.NET RADIO NUMBER IS REQUIRED!
- NOT WIDELY USED, AND CONSIDERING ALTERNATE SOLUTIONS

RMHAM Talk Group	RMHAM TG#	Brandmeister TG#
Northern Regional	TG 721	310813
Central Regional	TG 720	310801
Southern Regional	TG 719	310816
Rocky Mountain	TG 700	Not Supported



INTEROPERABILITY WITH NON-DMR MODES (LIKE ALLSTAR)





Allstar to DMR Bridge

GATEWAY TO ALLSTAR, COLCON AND FUN MACHINES

- RMHAM CONTROL OPERATORS HAVE ACCESS TO EQUIPMENT THAT CAN BRIDGE OUR DMR NETWORK INTO ALLSTAR (COLCON AND FUN MACHINES.)
- A SIMPLE MOBILE RADIO OPERATING ON ONE OF OUR REPEATERS
- HAS AN ALLSTAR INTERFACE BOARD (EITHER RTCM OR URI-X + PI)
- DMR VOICE CALLS ARE DEMODULATED TO BASEBAND AUDIO AND SENT TO THE ANALOG SYSTEM ... AND VICE VERSA.
- USED DURING
 - EMERGENCIES FOR ARES AND AUXCOMM
 - MONTHLY ARRL COLORADO SECTION NET
 - EOSS LAUNCHES
- INVESTIGATING AN UPGRADE TO A DIGITAL TRANSCODING SOLUTION ... LIKE DMR LINK OR SIMILAR





HAVE YOU HAD ENOUGH ?

ONLY 8 MORE SLIDES





SAMPLE NETWORK DIAGRAMS FOR OUR DISCUSSION

- HUB AND SPOKE
- LOOP

SAMPLE NETWORK DIAGRAM - HUB AND SPOKE WITH VPN



SAMPLE NETWORK DIAGRAM - LOOP MICROWAVE WITH VPN





SAMPLE CALL FLOW DIAGRAMS





SAMPLE IPSC CALL FLOW - NORTHERN TG 721



SAMPLE IPSC CALL FLOW – CENTRAL TG 720



SAMPLE IPSC CALL FLOW - ROCKY MOUNTAIN WIDE TG 700



SAMPLE IPSC CALL FLOW - ROCKY MOUNTAIN WIDE TG 700



SAMPLE IPSC CALL FLOW – NORTHERN TG 721 WITH BRANDMEISTER





QUESTIONS?



