Ham Radio Networking v 1.0

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Ham Radio Networking

- Uses commercially available Wi-Fi access points
- Custom firmware for ham radio use
 - Moves Wi-Fi radios into ham bands adjacent to Part 15 bands!
- Based on OpenWRT (which is based on Linux)

The Ham Radio (Part 97) Digital Networking Bands

- 902-928 MHz
- 2.4 GHz 2300-2310; 2390-2450 MHz
- 3 GHz 3300-3500 MHz
- 5 GHz Band 5650-5925 MHz

2.4 GHz – 2300-2450 MHz	2.4 GHz -	- 2300-2450	MHz
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Ηz	Channel	-2	-1	0*	1	2	3	4	5	6
5	Status	Ham I	Band			Shared	Ham and	I ISM/WiF	i Band	
2.4	Freq	2.397	2.402	2.407	2.412	2.417	2.422	2.427	2.432	2.437
				*Not available	e for use					1

ISM - industrial, scientific and medical

3 & 5.8 GHz Bands

Ηz	Channel	76	77	78	79	80	81	82	83	84	85	86	87
4 Q	Status		Ham Band										
ů.	Freq	3.380	3.385	3.390	3.395	3.400	3.405	3.410	3.415	3.420	3.425	3.430	3.435
	-	88	89	90	91	92	93	94	95	96	97	98	99
								Band					
	[3.440	3.445	3.450	3.455	3.460	3.465	3.470	3.475	3.480	3.485	3.490	3.495

52 Channels, 7 Non-Shared, on 5.8 GHz

5.8 GHz	Channel	133	134	135	136	137	138	139	140	141	142	143	144	145
00	Status					Sł	nared Han	and ISM	WiFi Bar	nd				
S	Freq	5.665	5.670	5.675	5.680	5.685	5,690	5.695	5.700	5,705	5.710	5.715	5,720	5.725
		146	147	148	149	150	151	152	153	154	155	156	157	158
	[5.730	5.735	5.740	5.745	5.750	5,755	5.760	5.765	5,770	5.775	5.780	5.785	5.790
		159	160	161	162	163	164	165	166	167	168	169	170	171
						St	nared Harr	n and ISM/	WiFi Bar	nd				
	l	5.795	5.800	5.805	5.810	5.815	5.820	5.825	5.830	5.835	5.840	5.845	5.850	5.855
		172	173	174	175	176	177	178	179	180	181	182	183	184
	1									Ham Band	1			
	[5.860	5.865	5,870	5.875	5.880	5.885	5.890	5.895	5.900	5.905	5.910	5.915	5.920

Refer to your local band plan for coordination

Mesh networking is a modern ham radio activity

But

It's just a network. It doesn't do anything...

It's all about the "Services"

Mesh Networking Services

- Services = things you can actually use
 - Keyboard to keyboard (IM)
 - Voice
 - Video
 - Docs (like Google Docs)
 - Web servers / pages
 - Store and forward (email)
 - Repeater linking
 - Pretty much anything you can do on the Internet subject to the Part 97 Regulations

Keyboard to Keyboard

IRC (Internet Relay Chat)

- Dedicated channels
- Ad hoc channels
- Ad hoc one-on-one chats
- Minimal bandwidth required
- Easy to use with minimal training
- Geographically-separate servers can be linked together.
- IRC Servers require some skill to set up and link together

IRC Example

		Hexthat: reybango @ freehode / #yeoman			-
HesChat Yiew Serve	er Settings Window	Help			
freenode	yeoman.io Modern	workflows for modern webapps		0 ops, 57 total	
 Imaginvascri Imaginvascri<	[09:25:50] [09:31:17] [09:45:43] [09:45:43] [10:10:37] [10:10:37] [10:10:37] [10:10:29] [10:16:20] [10:26:44] [10:33:18] [10:33:18] [10:33:18] [10:33:18] [10:33:18] [10:30:58] [13:00:58] [13:00:58] [13:14:58] [13:14:38] [13:14:25] [13:14:34] [13:22:56] [13:22:56] [13:22:66] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:22:65] [13:25:65] [13:37:55]	<pre>webapps Topic for #yeoman set by paul_irish!~paul_iris@ve.hsh6wjwx.vesrv. cm (Wed Jul 18 19:19:13 2012) .NickServ. You are now identified for RoyBango sharimal (~sharimal@71-93-37-196.static.snlo.ca.charter.com) has joined bobuponge has quit (Remote host closed the connection) ericduran[away is now known as ericduran vtali has quit (Ping timeout: 250 seconds) gnuelliam (~william@ir7.134.108.51) has Joined gnuelliam (~william@ir7.314.108.51) has Joined gnuelliam (~william@ir7.314.108.51) has left timmywil (~timmywil@host-68-169-175-226.WISOLT2.epbfi.com) has joined cropdev_ has quit (Remote host closed the connection) cropdev_ has quit (Remote host closed the connection) coded log from Fri Agr 12 10:33:18 2013 now talking on Ryeoman topic for Byeoman is: yeoman in Modern workflows for modern webapps Topic for Byeoman set by paul_irish!~paul_iris@ve.hsh6wjmx.vesrv. cm ((web Jul 10 20:0012) 2002) -HickServ You are now identified for ReyBango. dyle (~dylam@c-67-100-200-58).hsd1.ca.comcast.net) has joined vtali (~wstal@c-67-100-200-58).hsd1.fl.comcast.net) has joined vtali (~wstal@c-67-100-200-580.hsd1.fl.comcast.net) has joined vtali (~wstal@c-67-100-200-580.hsd1.fl.com</pre>	b-ot ben_al blackj colinw dwco doyle epokwe	eend s erafina man id men dia man[away ot w o sul e i off	

Keyboard to Keyboard

MeshChat

- Automatically links to other MeshChat services discovered on network
- Multiple channels (optionally)
- Supports file upload/download ("Dropbox")
- Runs nicely on a Raspberry Pi

MeshChat

CHAT	FILES	STATUS			LOGOUT
			Mesh Chat v1.0		
		Zone: LWMeshChat Call Sign: K7FPV		Node: laytonwestdist Updated: 14 seconds	
Send	a Message	1. I	Mesh Chat	Users	1
New N	Aessage		Call Sign	Node	Last Seen
Ente	r message h	ore .	K7FPV	laytonweatdistrict	10/11/16 10:51 AM
Chann	el: Everything	SEND			

Messages	Search: stolar a		Channel:	Everything
Time	Message	Call Sign	Channel	Node
10/11/16 10:50 AM	This is meshchat. It is a messaging and file sharing app for AREDN mesh networks. It is fully redundant and decentralized. It works with spotty links and requires very little bandwidth.	K7FPV		laytonwestdist rict

VOIP (Voice Over IP) Phone calls over the network



VOIP (Voice Over IP)

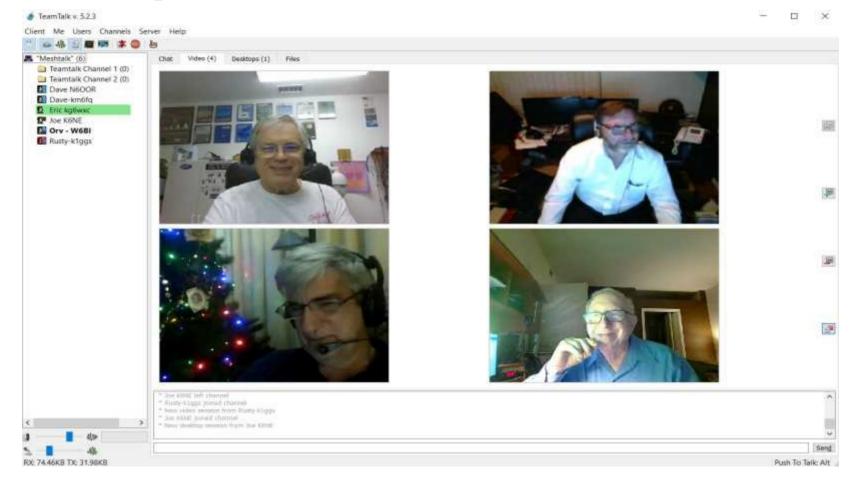


VOIP (Voice Over IP)

Voice Chat

- TeamTalk, etc.
- One to one
- Many to many (chat room)
- Can set up as many channels as necessary
- Multiple, simultaneous conversations
- Speaker/microphone or headset (HIGH quality audio)
- PTT (Push To Talk), VOX (Voice-operated Transmit) or open microphone
- Video, file sharing, desktop sharing all available

VOIP (Voice Over IP chat server)



Video – Webcams

Webcam screenshot

Via mesh network - 3 hops on 2.4 & 5.8 GHz, about 40 miles total path length



Video - Webcams



Offling CPG 62.26% RAM Usage T00Mb Parformance Tips Try Agent

Video - Webcams

N Callela J Ilic



Video - Webcams



Editable Docs

Etherpad - like Google Docs

- Concurrent editing by multiple authors
- Text & tables only

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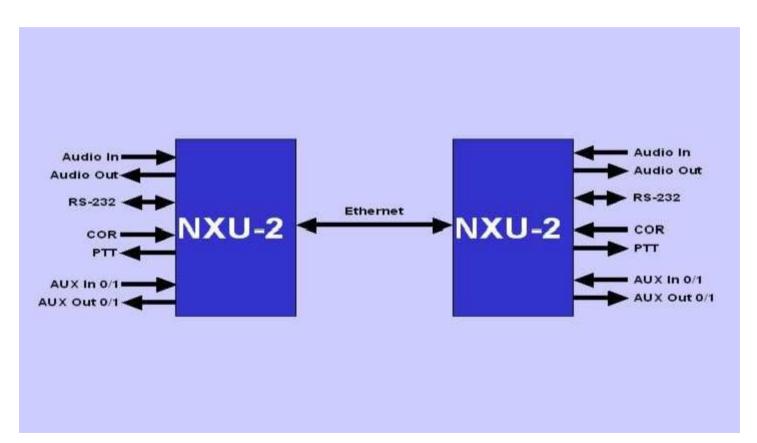
Email

- Sendmail email servers
- RMS Express / Outpost / Winlink
- Citadel BBS

Old School – BBS!

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RolP Repeater Linking JPS Communications, SkyMira, etc.



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What's out there??

Ubiquiti Access Points

- Available for four amateur bands
 - For outdoor use: weatherproof
 - Higher power 28 dBm (most models)
- Built-in gain antennas in many models
- Sophisticated software-defined transceivers (dual chain!)
- MIMO/802.11n (most models) enhances throughput substantially
- POE (Power Over Ethernet) only one cable required to node.
- Like handie-talkies: low power, line of sight
 - •Used mostly through hilltop relays

For the home:

Ubiquiti Nanostation M2/M5*





Ubiquiti PowerBeam M5*





Ubiquiti Rocket M2/M5*



- For the high-level access points: mountaintops & hilltops
- Requires external antennas

*\$77/85 - Amazon

Ubiquiti Rocket M2/M5





On back of With MIMO MIMO sector antenna (\$85-125) Omni antennas (~\$160)

Other Mesh Station Requirements

- Shielded (per Ubiquiti) outdoor network cable (\$25-75)
- Dedicated computer for mesh (standalone network – no Internet access)
- Dedicated network switch (optional)
- Clear line of sight, because...

Line of Sight

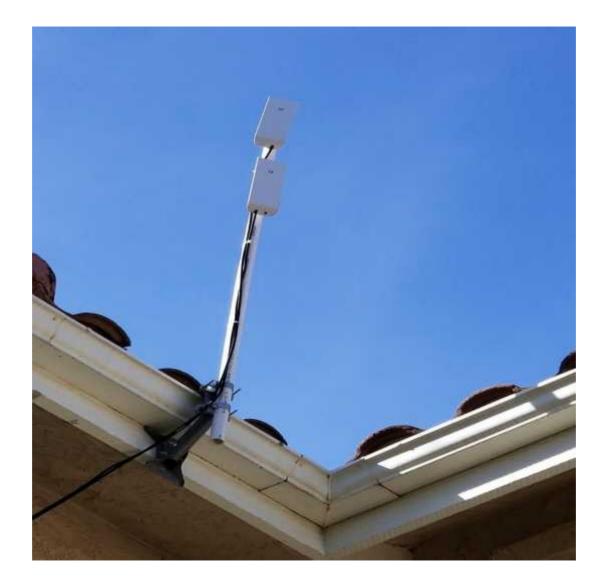
"Microwaves can go 15 miles or through one tree"

Higher is better!



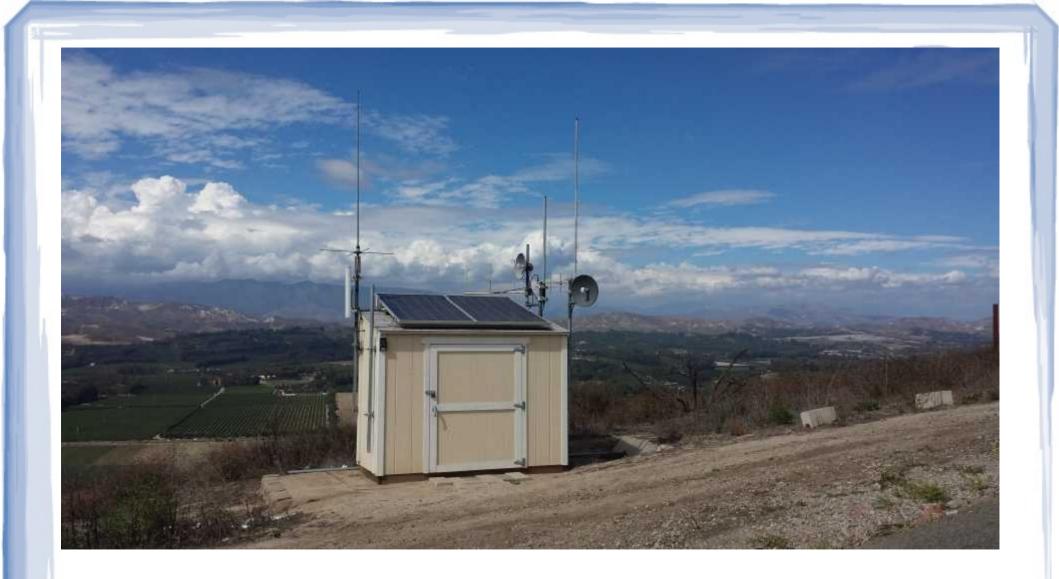
• Note Nanostation M2 at top of mast.

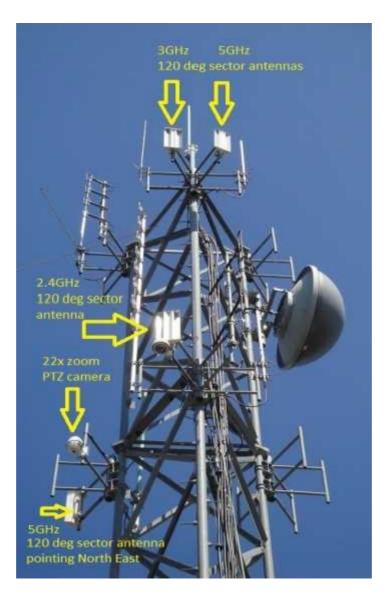


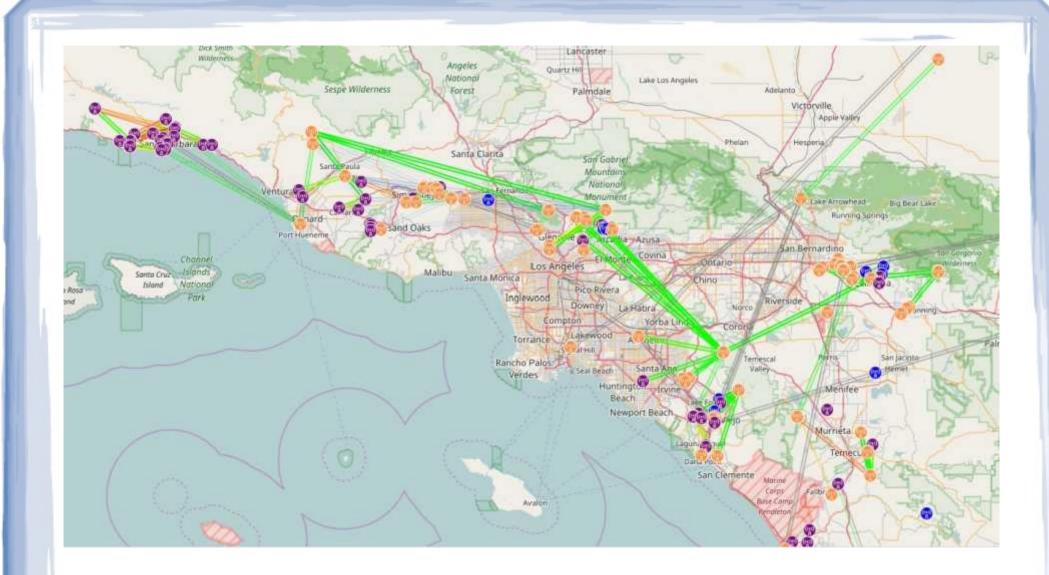












Ham Network Software Development Group

- Amateur Radio Emergency Data Network (AREDN)
 - https://www.arednmesh.org/
 - Software downloads
 - How-Tos
 - FAQs
 - Documentation
 - Forums

You Need a Ham License!

- Technican (entry-level) license is sufficient (Morse code no longer a requirement)
 - http://www.arrl.org/getting-your-technician-license
 - 35 multiple-guess questions
 - http://www.arrl.org/question-pools
- Tests administered locally by VEs (Volunteer Examiners)
 - http://www.arrl.org/find-an-amateur-radio-license-exam-session
 - Or contact your local ham radio club
 - Minimal cost for test
- Technician license also provides voice privileges on VHF & UHF bands, limited HF privileges

Questions?

The Ham Radio Internet

• orv.beach (at) gmail.com





An International Association of Technology & Computer User Groups