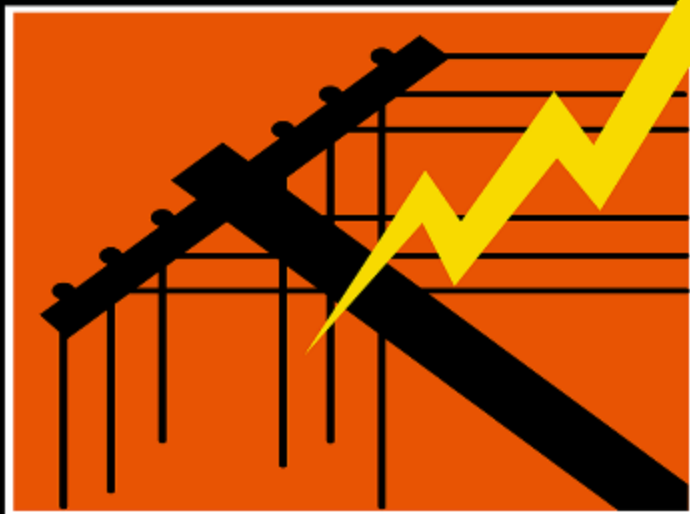
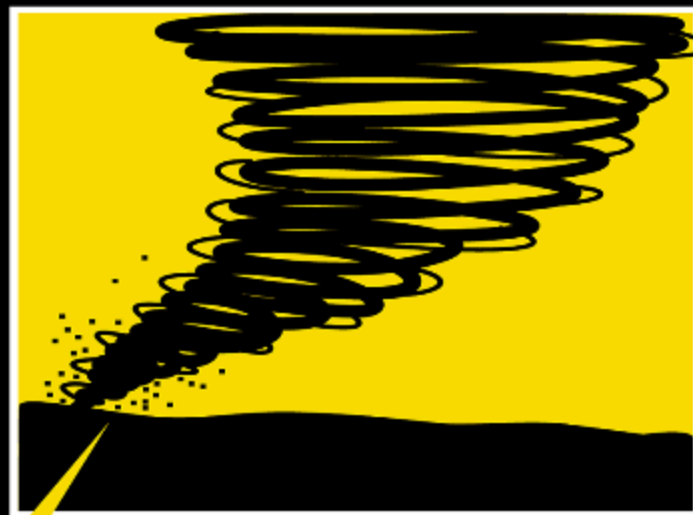
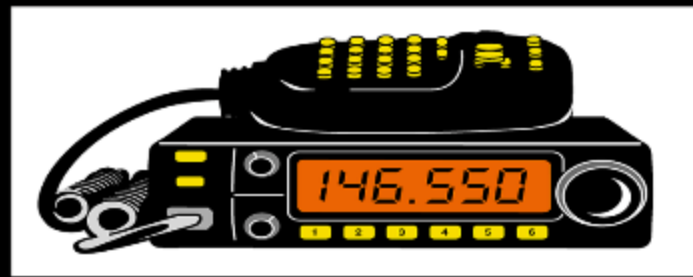


**WHEN
ALL
ELSE
FAILS...**



**AMATEUR
RADIO**



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Ham Radio MESH Networks

also know as

High-Speed Multimedia Mesh (HSMM)

Broadband-Hamnet (BBHN)

*Amateur Radio Emergency Data
Network (AREDN)*

Wayne Gronlund, N1CLV
Connecticut Assistant Section
Emergency Coordinator



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AREDN

At the center of emergency
PREPAREDNESS



Presented to the
COLUMBIA AMATEUR RADIO CLUB
Bill, W1GTT
January 6, 2020



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BASIC MESH CONCEPTS

Adapted from
AREDNmesh.org and/or
BroadbandHamnet.org



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- MESH Concept
- Power over Ethernet (PoE)
- Optimized Link State Routing
- Frequency Allocation
- Video Transmission
- VoIP Telephony
- Device-to-Device Linking



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- MESH is a wireless data network; it is not application software. It is a special firmware build that transforms consumer wireless gear to a specialized ham radio function. It then uses application software to transport your data from place to place.



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- A MESH network is a highway over which data travels. Turning on two mesh nodes loaded with the mesh firmware creates a data network. This network carries your data and allows your local computer to use information or applications stored in other locations.



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- MESH nodes were originally consumer wireless routers but changed function when the firmware was changed.
- After conversion, the WAN, LAN and Wi-Fi ports are linked using special rules and no longer operate like a normal wireless router.



- Some devices like the Ubiquiti Bullet have only a single network connection. Others like the Linksys WRT54x series or the Ubiquiti AirRouter have multiple LAN jacks and the Internet (WAN) jack.



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- MESH nodes are self discovering, self configuring, self advertising and fault tolerant.
- MESH nodes are small, portable, low-power and inexpensive. They are easily battery powered.



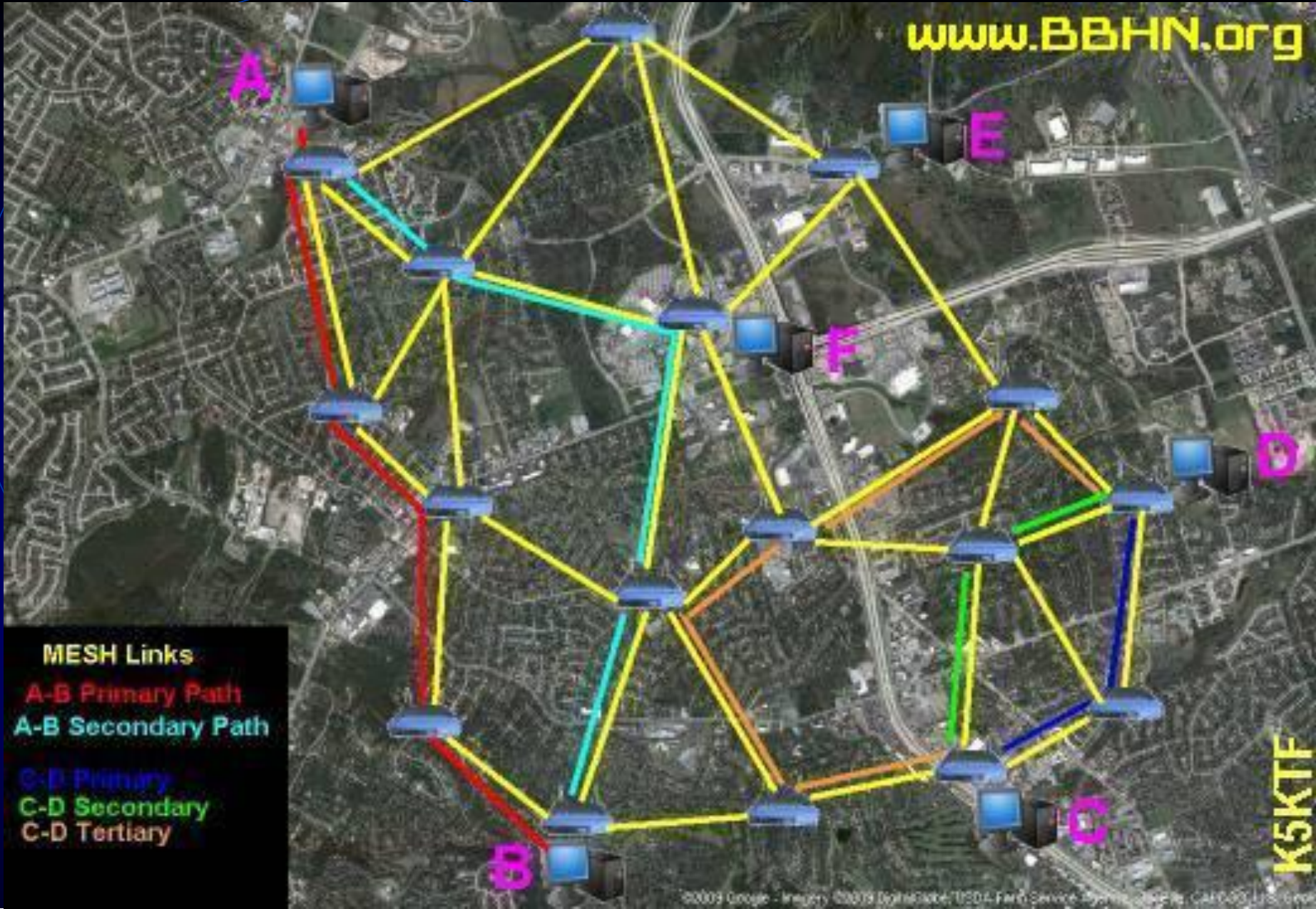
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- **Power over Ethernet or PoE**
describes any of several standardized systems which pass electrical power along with data on Ethernet cabling. This allows a single cable to provide both data connection and electrical power to devices such as wireless access points or IP cameras.



- The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad hoc networks, which can also be used on other wireless ad hoc networks.

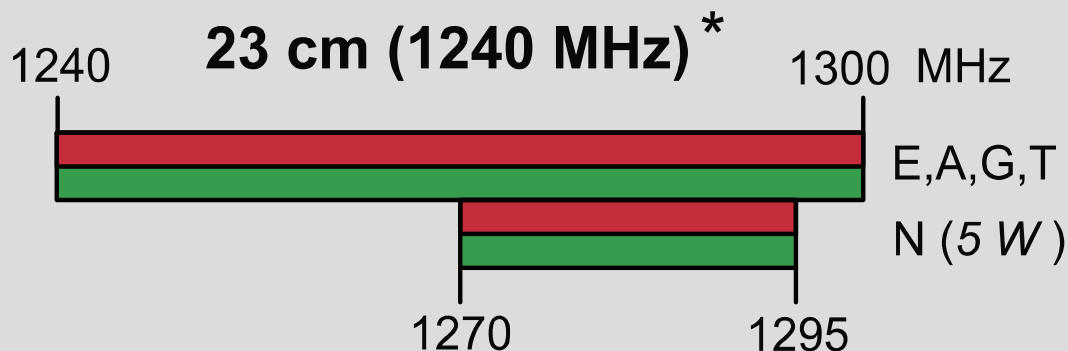
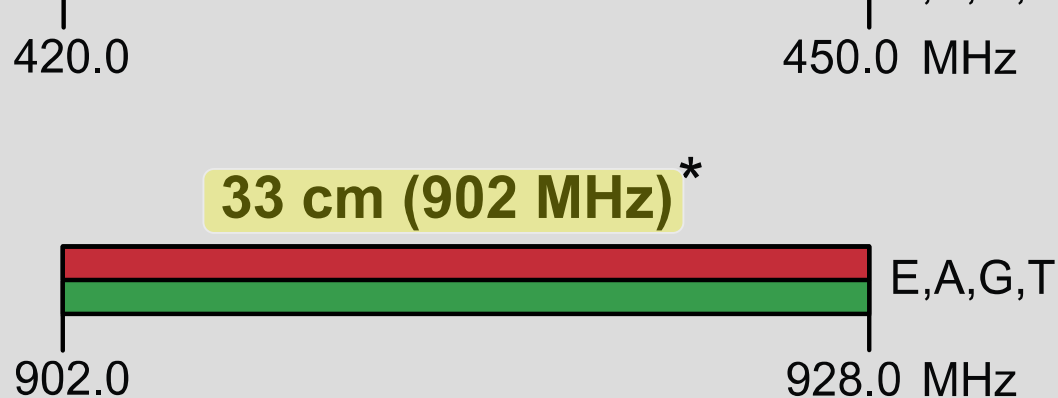
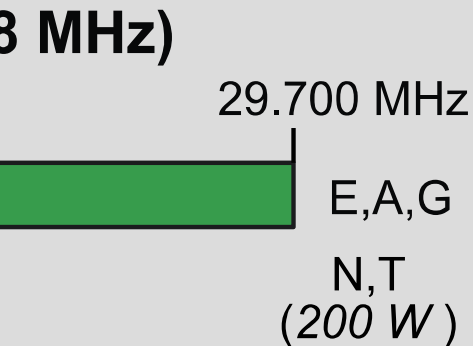
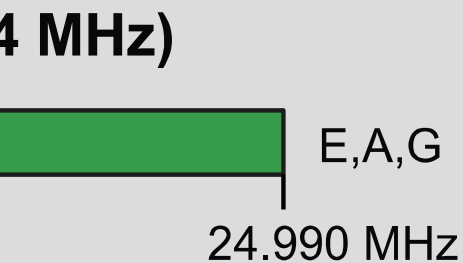




MESH Links
A-B Primary Path
A-B Secondary Path
C-D Primary
C-D Secondary
C-D Tertiary

K5KTF





All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz *	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

* No pulse emissions

N = N

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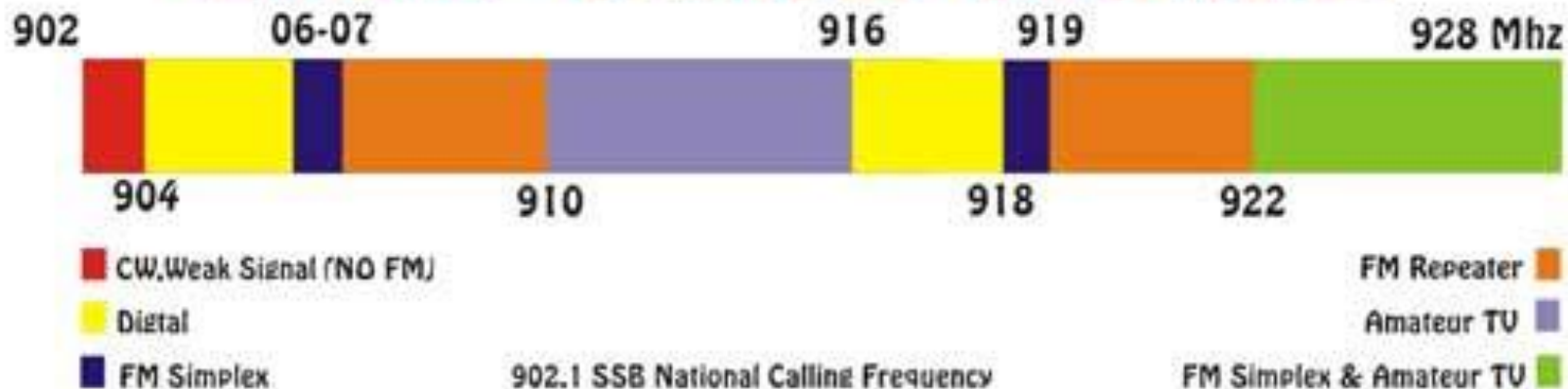
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900 Mhz Band



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AREDN Offers 2 Non-Shared Channels on 2.4 GHz

2.4 GHz	Channel	-2	-1	0*	1	2	3	4	5	6
	Status	Ham Band			Shared Ham and ISM/WiFi Band					
	Freq	2.397	2.402	2.407	2.412	2.417	2.422	2.427	2.432	2.437

*Not available for use

24 Non-Shared Channels on 3.4 GHz

3.4 GHz	Channel	76	77	78	79	80	81	82	83	84	85	86	87
	Status	Ham Band											
	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
	Channel	88	89	90	91	92	93	94	95	96	97	98	99
	Status	Ham Band											
	Freq	3.440	3.445	3.450	3.455	3.460	3.465	3.470	3.475	3.480	3.485	3.490	3.495

Refer to your local band plan for coordination

52 Channels, 14 Non-Shared, on 5.8 GHz

5.8 GHz	Channel	133	134	135	136	137	138	139	140	141	142	143	144	145
	Status	Ham Band shared with U-NII-2C/wifi/unlicensed												
	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
	Channel	146	147	148	149	150	151	152	153	154	155	156	157	158
	Status	Ham Band shared with U-NII-3/wifi/unlicensed												
	Freq	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
	Channel	159	160	161	162	163	164	165	166	167	168	169	170	171
	Status	Ham Band shared with U-NII-3/wifi/unlicensed												
	Freq	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
	Channel	172	173	174	175	176	177	178	179	180	181	182	183	184
	Status	Ham Band												
	Freq	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; ★ 5825 to 5850 Shared under Part 15.247 with a limited number of WISP operators and may be encountered at tower sites



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Routers Usable for MESH

Linksys WRT54GS (not AREDN)

Ubiquiti airMAX Series
(Nano, Pico, AirRouter, etc)

MikroTik, TP-Link, GL-iNet, etc

Raspberry Pi Computers



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Manufacturer/Model	Band			
	900Mhz	2.4Ghz	3Ghz	5.8Ghz
Ubiquiti Networks (www.ubnt.com)				
AirGrid (XM revision/old)		M2		M5
AirGrid (XW)				AG-HP-5Gxx**
AirRouter		M2		
AirRouter HP		M2		
Bullet		M2		M5
Bullet Titanium		M2		M5
NanoBeam (XW)		NBE-M2-13		NBE-M5-16/19**
NanoBridge	M9	2G18	M3	5G22/5G25
NanoStation Loco (XM)	M9	M2		M5
NanoStation Loco (XW)		M2**		M5**
NanoStation (XM)		M2	M3	M5
NanoStation (XW)		M2**		M5
PicoStation		M2		
PowerBeam ⁽³⁾		PBE-M2-400**		PBE-M5-300/400/400ISO**
PowerBeam				PBE-M5-620**
Rocket (XM)	M900	M2	M3	M5
Rocket (XW) ⁽⁴⁾				M5**
Rocket Titanium		M2		M5
Rocket Titanium (XW) ⁽⁴⁾				M5
TP-Link				
CPE (v1.0)		CPE210		CPE510
CPE (v1.1)		CPE210		CPE510
CPE (v2.0)		CPE210		CPE510
-				
GREEN = "GO"	AREDN Supported			
RED="STOP"	No Compatibility or Support			
ORANGE="CAUTION"	High Confidence of compatibility. Included in current release, but not rigorously tested			
YELLOW="RESEARCHING"	Under research for future support consideration.			

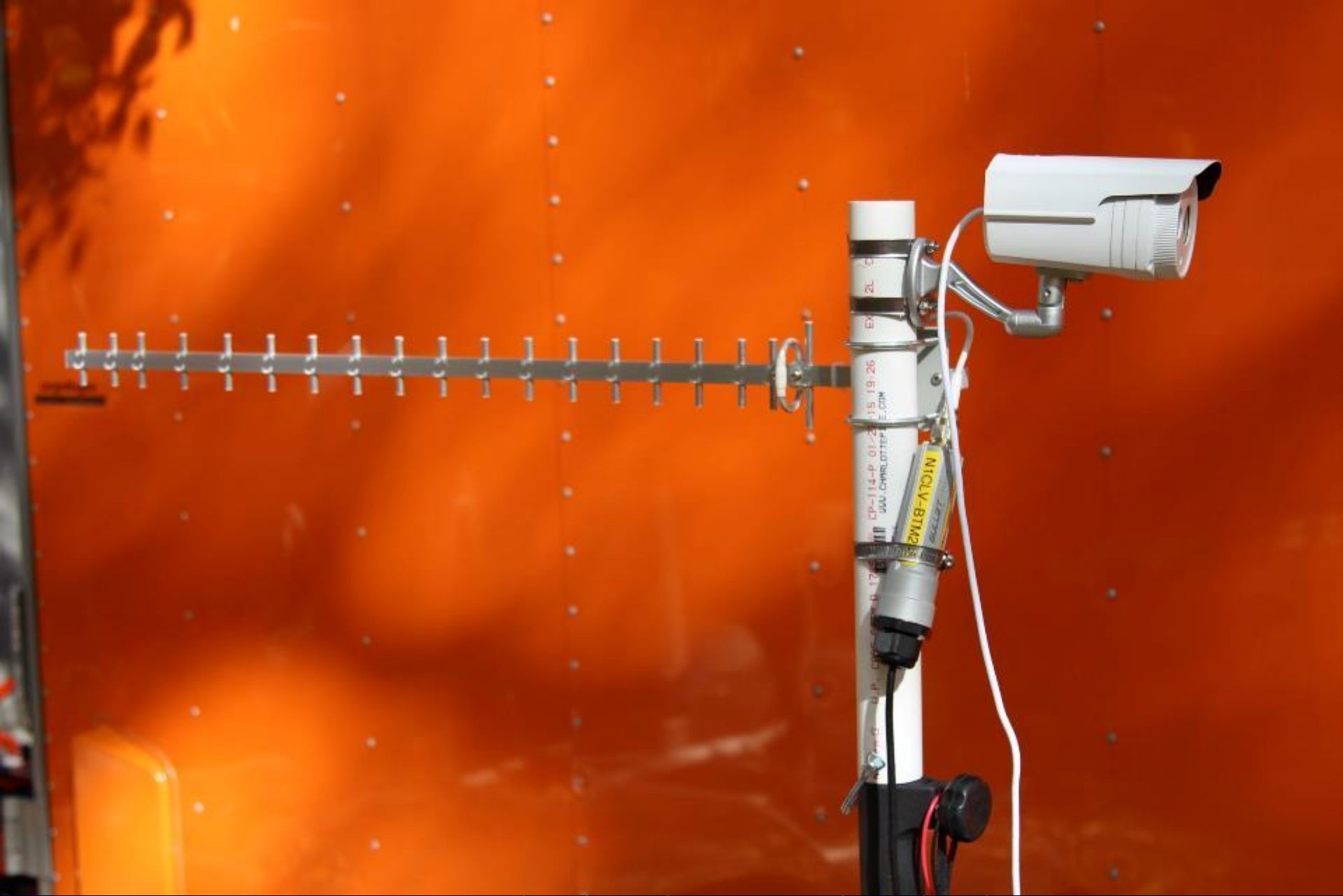


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ENTERTAINMENT AND
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- Queue the LIVE demonstration of ad hoc networking by MESH devices along with video data transfer and VoIP telephony!



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