A Tale of Two Meshes

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Our group supports the Medtronic Twin Cities Marathon and several other large events. Back in 2011 we got some money from Dan Skripka, KE8TX and ordered a selection of outdoor rated Ubiquiti mesh capable Wi-Fi radios for our Lab. Doug, N0NAS, liked the idea of a backbone network on 5 GHz, as 2.4 GHz was congested. User access to the backbone would be on 2.4G. The noise floor on 2.4G with thousands of cell phone carrying people at an event is quite significant.

We put up a short test link and decided after a year the range was bad and the all-weather reliability was not so great. The value of short range radio links on a 26.2 mile Marathon race course across two cities was debatable. We did have a lot of web database users and 200 injured runners in aid stations or on busses and needed to cover our sprawling race course with advanced services, so moved ahead with some 5 GHz omnidirectional building-top mesh nodes. These seem to have a line of sight range, with good (9dB) antennas, of a mile or so. (A bit longer, dish to Omni, say 1.5 miles). The idea was to use dishes and Ubiquity TDM software for any long haul paths. Note any obstruction, such a leaf, will impair microwave signals.

Test Results (Thanks N0NAS, KC0LQL)

Mode	*Speed*	*Range*	*Notes*
D-Star DD Mode	90kbps	10 miles LOS	Half duplex Omni>Omni
5 GHz NanoStations	~20mbps	2 miles LOS	Poor over a badly aimed path
5 GHz Bullet, 9dB ant	>20mbps	1 mile LOS	Omni-Omni @100 feet (limited vertical sep.)
5 GHz Bullet>Bullet	>20mbps	1-2 miles LOS	Dish>9dB Omni @100 feet
5 GHz Rocket>Rocket	>5 mbps	1-2 miles LOS	5dB paddles @30 feet on trailers
5 GHz Dish > Dish	6-60mbps	9.1 miles	AirGrid M5 27 dB (observe polarity)

I pushed hard for the use of Part 15, as our served agencies were hospitals, EMS, a race and a law enforcement agency. The Great Crypto Debate was not started. We used home-made OPENWRT +OLSR builds (Thanks Peter, KD8GBL) and static /24 address blocks per node to match our existing D-Star DD mode network. This also simplified our routing. One of our served agencies noticed some infighting on one of the ham radio mesh software sites. I told them that was not an issue for us.

Then one day (2017?) our new Race Director said, looking at me, "you know- our start line is in Minneapolis and our new Race Operations Center is in St. Paul. Some live start line video in here (the ROC) would be good."

So we had a mesh omni antenna in downtown St Paul, overlooking the finish area. And we had good access to a site in Minneapolis. The distance was 9.1 miles, ~125 dB of path loss. I tried to request a new antenna for our St Paul site in conjunction with a certain large professional football game. That request bounced all over and was rejected. I tried again with our EMS leadership. They asked of this was "all hazard" or was just for hams. I said not just for hams. We got the site.

As it has turned out, we have used our TWINSLAN Part 15 Medical Command mesh capability for law enforcement and video feeds used for nonprofit events. I told the hospitals crypto was fine if needed. Jitsi, an open source conference bridge uses SSL I think. I get a call a week from angry COMLs telling me I have no idea what I am doing. KD8GBL monitors the network via Nagios.

Early in the 2020 lockdown we had a meeting and some outdoor gatherings with some local ARES affiliated hams. I was getting the same speech "your network is private and commercial". And they wanted the passwords. So, we decided the best answer for general ham use was the popular plug and play ham radio mesh- AREDN(r).

AREDN standards were published (channels 180, and -2) and a 10 MHz bandwidth. Peace has been restored and when we need live streamed sports video with sponsor messages (as we did three times for public service events with our portable gear in February 2021), HIPAA or hostage rescues we are good- we use Part 15. And when hams want to connect up their home networks via tunnels we are also good on AREDN. Problem solved.

Several area groups have talked to us. Willmar, MN- the govt. folks were fascinated by Part 15 between fire stations. St Cloud, MN is all in on AREDN. And the Fargo folks sent a note- the ARES is all in on AREDN, (but did mention WebEOC), a medical provider up there was scratching his head on the role of Part 97 and HIPAA.

In March, 2021, I attended about half of the MNVOAD State Conference. There was a presentation by the Red Cross on the Multi Agency Resource Center (MARC). The idea is these are set up in response to disasters and persons impacted can go in, and sign up for services. The enrollment process may/does involve sensitive personal and or medical data. (Note this private data is apparently not transmitted to/from shelters per se). The speaker talked at length about the importance protecting the privacy of this data. There was a discussion of the community recovery process being lengthy - like 120 days.

So in Minneapolis/St. Paul MN we have two ham radio sponsored mesh networks. One, TWINSLAN Medical Command, is air-gapped from the Internet, and supports all hazard public safety and medical applications and our database without control operators. The ARES folks have an AREDN /Part 97 capability. Our mobile mesh tower/generator fleet, more than 10 trailers, is set up for both meshes. The trailers and a local command truck have portable cameras and can live stream on request. The idea is to use the right technology for the mission.

5Ghz Mesh High Speed Part 15* "TWINSLAN Medical Command Network"

In production for live video, dashboard apps, voice and family reunification
Encryption is supported for medical records, law enforcement as needed

* Caused the "Revolt of the COMLs"