# AREDN Test at the 2017 Marine Corp Marathon

Presentation to Alexandria Radio Club

09FEB2018

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# Background

- DSTAR voice and data have been used for medical communications at the MCM for several years
  - "security through obscurity" rationale for digital voice
- ID-1 used for high-speed data transfers of runner database information
  - 9600bps packet radio as a backup means of data communication
- These technologies have served the MCM well for several years
- *Problem: The Icom ID-1 is no longer in production and there is no direct replacement*
- *Problem: Packet access to database is cumbersome*

# Alternatives

- Rely on 9600bps packet radio only
  - With an emphasis on improving the operator interface to enter information into the database
- Utilize Amateur Radio Emergency Data Network (AREDN) mesh networking gear operating in the ham-only portion of 2.4GHz spectrum

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

**Exclusive ham-only spectrum**

# Typical AREDN Node

2.4 GHz 9 dBi
Omni Antenna
$58

**Alternate Antenna**

2.4 GHz 15 dBi
Grid Antenna
$45

**<$250 per node**

Your existing computer

Surplus Mast Poles
4@4ft: $25

Bullet M2 Titanium
$115 (includes power supply)

100 ft. CAT5E Cable
$25

# Prior 2015 MCM Test

- Scanned WiFi channel 1 during MCM 2015 with an AREDN-enabled radio system
- Conclusion: interference from commercial/consumer WiFi routers would have made AREDN-only communications extremely difficult

# 2015 MCM Test Results (Channel 1 WiFi Scan at Noon)

**wa4kfz-mesh2 WiFi scan**

Refresh Auto Quit

| Sig | Chan | Enc | SSID | MAC | Vendor |
|---|---|---|---|---|---|
| -52 | 11 | * | unknown | F41FC2:A7DD60 | |
| -62 | 1 | * | LTS_WAP | 24A43C:4029C1 | |
| -62 | 6 | * | HOME-1E89-2.4 | C07CD1:6D4818 | |
| -63 | 11 | * | unknown | F41FC2:A74820 | |
| -63 | 11 | * | unknown | F41FC2:A74823 | |
| -64 | 11 | * | NETGEAR86 | 200CC8:130A66 | |
| -64 | 11 | * | unknown | F41FC2:A7DD61 | |
| -65 | 11 | * | unknown | F41FC2:A7DD63 | |
| -65 | 6 | * | unknown | C07CD1:6D4819 | |
| -66 | 11 | * | unknown | F41FC2:A7DD62 | |
| -66 | 8 | | xfinitywifi | BEB313:02C5B0 | |
| -67 | 11 | * | bcswifi4 | A42B8C:E74BA8 | |
| -67 | 1 | * | Verizon-MiFi5510L-8359 | 0015FF:8C8359 | |
| -68 | 6 | | GHCO-guest | 186472:134AA2 | |
| -69 | 6 | * | GHCO-HQ | 186472:134AA1 | |
| -69 | 6 | * | GHCO-Visitor | 186472:134AA3 | |
| -70 | 1 | * | NEMA_Guest | 543D37:3894B8 | |
| -70 | 6 | * | unknown | 186472:134AA0 | |
| -71 | 11 | * | GHCO-Visitor | 24DEC6:7CFC52 | |
| -71 | 1 | * | LG-P769 22 | C4438F:4948C5 | |
| -72 | 1 | * | NEMA | 543D37:7894B8 | |
| -72 | 6 | * | RoamWiFi-020684 | 5CE7BF:E050CC | |
| -73 | 6 | * | RP-ASSN | 2AA43C:65D4B6 | |
| -73 | 8 | | unknown | 0014A5:8AA7CF | |

wa4kfz-mesh2 WiFi scan

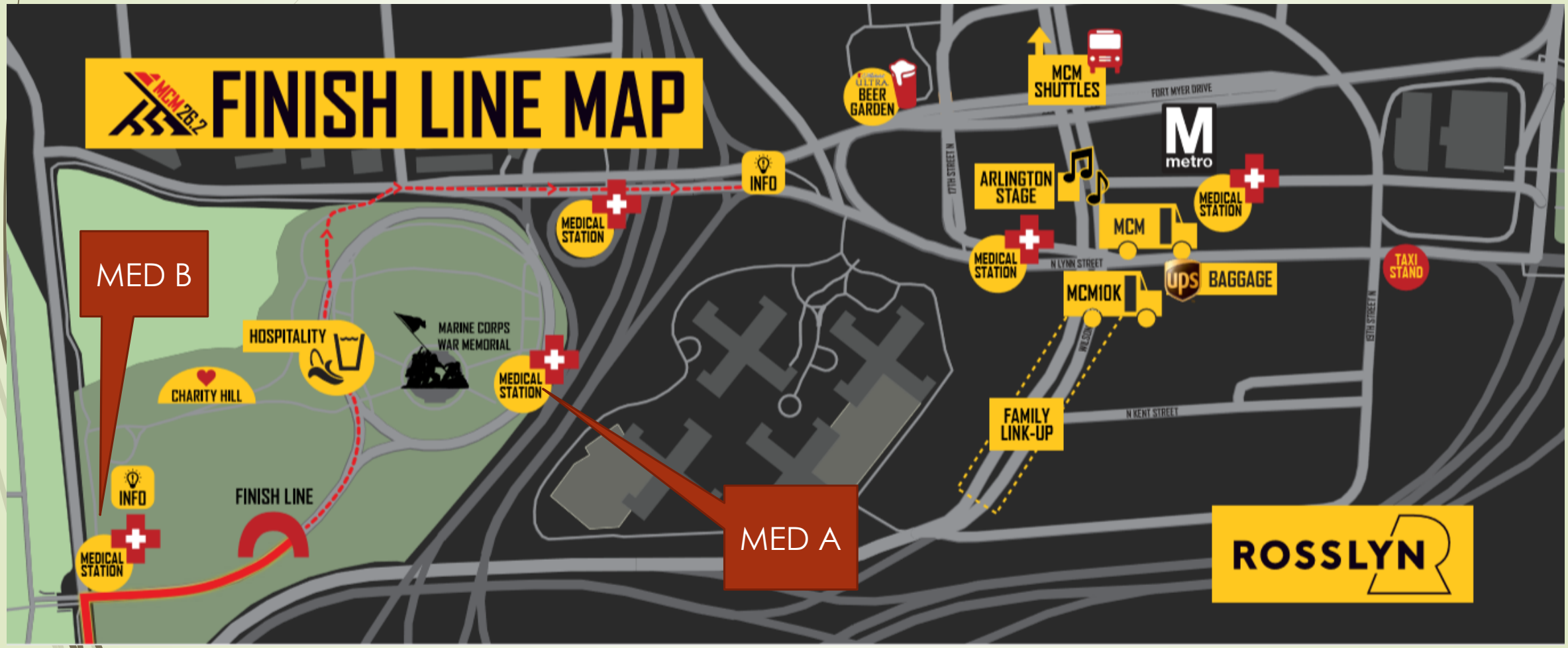
| | | | | | |
|---|---|---|---|---|---|
| -74 | 1 | | Capitol Room | 00125F:0B6F62 | |
| -74 | 8 | * | barefoot2014 | ACB313:02C5B0 | |
| -75 | 1 | | Arlington Tower Public WiFi | 001174:F02EA0 | |
| -75 | 8 | * | unknown | AEB313:02C5B0 | |
| -78 | 1 | * | P95Z8 | F8E4FB:4B372E | |
| -78 | 4 | * | PhatMermaid | E4F4C6:0FF541 | |
| -79 | 11 | | xfinitywifi | 5A238C:B0A469 | |
| -79 | 1 | * | FiOS-N9EZ1 | 485D36:2CDE70 | |
| -79 | 6 | * | ClaudeyWithAChanceOfRain | E8DE27:F96292 | |
| -80 | 1 | * | GHCO-Visitor | 186472:134A63 | |
| -80 | 1 | * | unknown | 186472:134A60 | |
| -80 | 1 | * | unknown | 24DEC6:7D0280 | |
| -81 | 1 | | BroadbandHamnet-20-v3 | 2E2F03:5352EE | Ad-Hoc |
| -81 | 1 | | riverplacesouth | 00022D:BF6295 | |
| -81 | 1 | * | ChronoBridge | 002722:1E78BA | Ubiquiti |
| -81 | 1 | * | FBR | 186472:1B8222 | |
| -81 | 1 | * | Old Town | 0A18D6:0B4385 | |
| -82 | 11 | * | unknown | 5A238C:B0A468 | |
| -82 | 1 | | GHCO-guest | 186472:134A62 | |
| -82 | 1 | | xfinitywifi | 961ACA:134430 | |
| -82 | 1 | * | FiOS-W7J1K | 485D36:26E07E | |
| -82 | 1 | * | NEMA | 543D37:781B48 | |

Operating in the commercial portions of the 2.4 GHz WiFi bands - communication link would be interference limited

# 2017 MCM Test

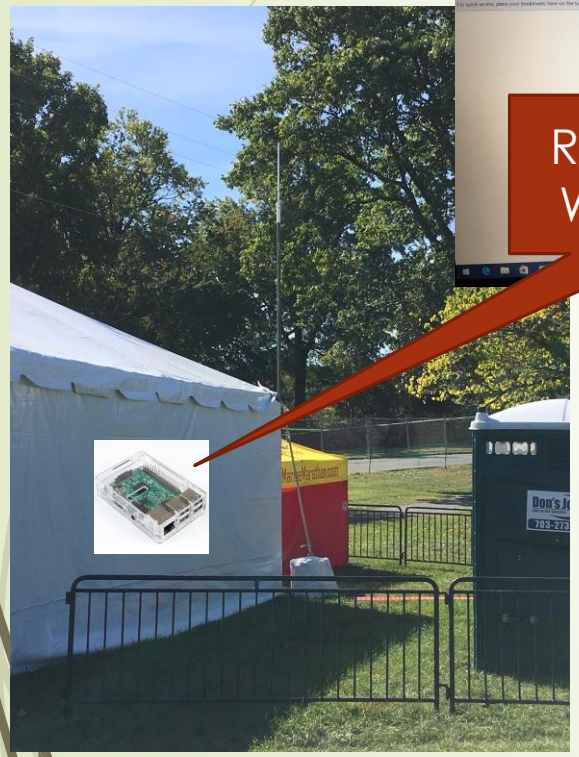
- Test two AREDN-enabled nodes in a point-to-point configuration
  - MED A to MED B
  - Channel −2 (ham-only portion of 2.4GHz spectrum)
- Examine performance before, during and after the race

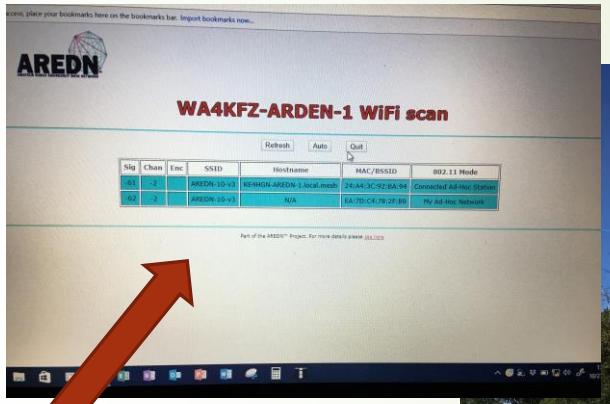
# MED Stations (2017 Finish Festival Map)

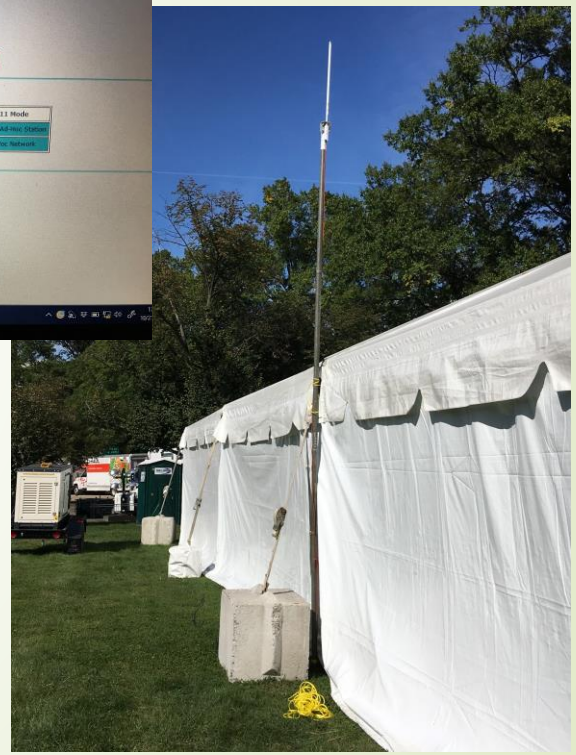


# 2017 MCM Test Configuration (Channel −2 Scan at Noon)


Raspberry Pi Web Server





**No interference from commercial/consumer WiFi**

**MED B**

**Approx. 0.25 mile**

**MED A**

# 2017 MCM Test Results

- No interference observed
- Data rate averaged >30Mbps before and after the race
- Date rate dropped to 19Mbps around noon
- Rate drop attributed to runners entering the Fresnel zone between the two antennas


**MED A - MED B Link at Noon**


**View from MED A toward MED B**

# 2018 MCM Baseline Goals

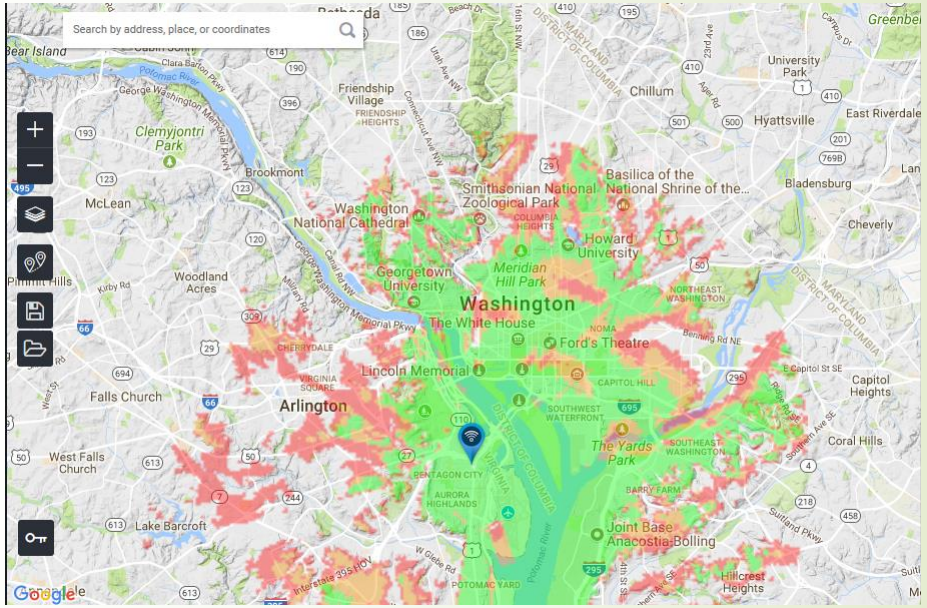
- Installed AREDN nodes at each MED location
- Maintain >10Mbps link performance during entire race event
- Determine if ID-1 radios can be replaced


**Keep It Simple!**

- **No VPN tunnels**
- **No security**
- **No "oops" on race day!**

# 2019 MCM Baseline Goals

- Establish AREDN sector node on DoubleTree Hotel roof
  - In addition to portable DSTAR repeater
- Add AREDN nodes (with directional antennas) at Aid Stations other than Rock Creek Park
  - Terrain makes this a unique case…
  - Need to explore path options to Rock Creek Park




**2.4GHz Path Prediction from DoubleTree Hotel Roof**

# 2020 MCM Baseline Goals

- Establish AREDN node connectivity to Rock Creek Park
- Determine if permanent AREDN node can be established at DoubleTree Hotel
  - Or identify other buildings that look over the entire race course…
- Retire use of ID-1 radios
- Add RF hotspot support to AREDN mesh network
  - DSTAR, DMR, System Fusion, etc. digital voice without repeaters