2016 New York City Marathon Recap

Amateur Radio operators volunteer to assist with communications and networking problems in this challenging environment.

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The New York City Marathon, sponsored by Tata Consultancy Services, is a hugely visible annual event, drawing runners from around the world. A record 51,388 finishers crossed the finish line on Sunday, November 6, 2016, making it the largest marathon in history.

More than 1 million spectators and thousands of volunteers lined the city streets in support of the runners, while millions more watched the television broadcast in 175 countries and territories, via national and international broadcast partners.

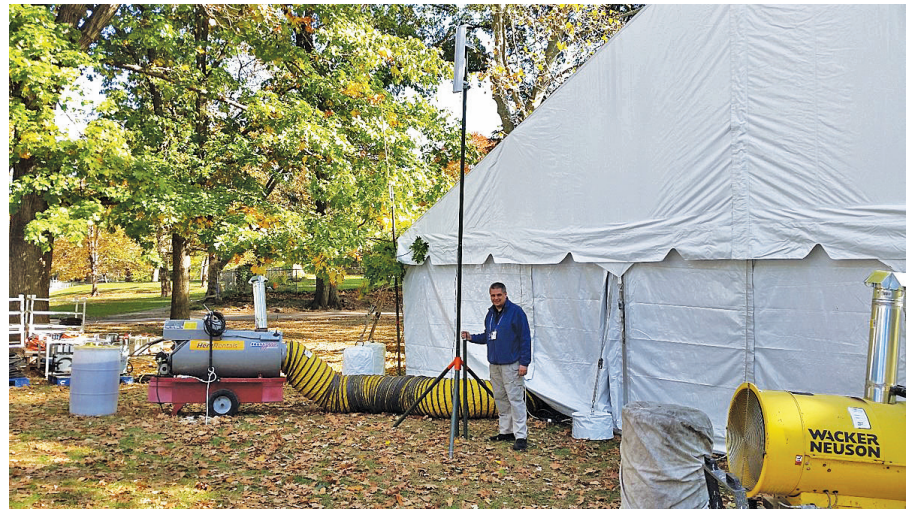

Figure 1 — N3UXK with the Wi-Fi antenna.

AREDN at the 2016 NYC Marathon

A large group of Amateur Radio operators provided essential communications to support the safety of race participants and organizers. An Amateur Radio Emergency Data Network (AREDN, **www.aredn.org**) mesh network and associated Voice over Internet Protocol (VoIP) telephony services provided the reliable communications infrastructure necessary for this important event.

Earlier this summer, Mike Hoeft, K2MPH, and Deborah Kerr, KC2GPV, reached out to me to inquire whether we could use the AREDN mesh equipment to address the networking problems of the Amateur Radio net control operators for the marathon. We discussed the notion of a simple link between the "Ham Trailer" and the Race Control Center (RCC) over a distance of less than 500 yards. The link was to support a variety of net control positions for this 55,000+ participant race, and allow them to update status information in real time using Google Docs. This information would be shared within the finish line area and from other points, including One Police Plaza at the NYPD Command Center downtown. Additionally, there was a request to support the operating positions with VoIP phones to reduce the noise level across the trailer and RCC, and to enable "off-air" conversations among all the operating positions inside and between these locations.

The finish line area was in a very challenging RF environment, where 900 MHz, as well as 2.4 and 5 GHz, were overwhelmed by a variety of Wi-Fi and other in-band signals overlaying a stew of intermodulation distortion (IMD) that was present for hours at a time during this event. We decided that the use of 3 GHz Ubquiti M3 Rockets and sector antennas borrowed from Randy, WU2S, would be the most reliable answer.

Our next step was a series of phone calls to marshal the essential equipment and expertise from volunteers and to adjust their assignments. This led to Dave, N3UXK, and Mark, N2MH, joining the team to help plan, build, test, and execute the key parts, which included redundant AllStar PBX switches, the aforementioned M3 Rockets, a pile of Grandstream GXP1450 VoIP phones, a slew of other Ubiquiti nodes, NETGEAR smart switches, power supplies, and support components (see Figure 1). It all had to be integrated, tested, and packaged before the first weekend in November — and it was, thanks to a great crew (see Figure 2).

Preparation

We set about refining what Mike and Deborah needed, and tracked the requirements as they evolved. Mark

Figure 2 — Members of the communication team in action. From left to right: Harvey, WS2Q; Anthony, W2NET; Ray, K2NET, and Bob, K2RSB.

configured two Beaglebone AllStar PBX switches using the approach that the two-line phones would have the same numbers on two different PBX switches, and that the two switches would have a non-looping trunk between them to allow all calls to ring on both lines, no matter which line and switch was used to originate the call. After some testing in mock setups at the Red Cross and at Mark's house, this and all the other issues were resolved. Some further challenges were that the AREDN nodes only allow for a maximum of 13 IP addresses from their DHCP server, so we had to split the network into several VLANs to create different DHCP pools. We also had a last-minute request for secure Wi-Fi access support, which we immediately put on channel 9 to get it away from our backup 2.4 GHz AREDN links on channel –2.

As part of this effort, we were also asked to update Google Docs with status information derived from APRS. APRS in New York City is a challenge, again due to the RF congestion issues on 144.39 MHz. Even the alternative of using APRSDroid and comparable cell phone and tablet apps for iPhones and iPads had issues due to the cell network congestion at some points of the race's course. We decided to use both technologies and to collect what we could on a "best effort" basis, but to later analyze both the radio and phone/tablet reports for quality and reliability. We had several operators moving on the course who provided detailed information as to their setups and networks. Early data showed that the RF links were surprisingly good.

We also received a request for integration into the VoIP telephone network that the New York City Roadrunners Club had established, but their interface specifications were never made available, so that will be a "to do" for the future. Another future objective is to set up support in additional medical and control points in Central Park but away from the finish line area. In the end, internet gateways, Asterisk PBX switches, smart (VLAN) switches, VoIP phones, laptops, tablets, and phones were all combined to make thorough use of our four DHCP pools.

Conclusion

We had a large number of changes to absorb during the process of getting this support activity done, but sometimes I think we take for granted all that is involved, and the breadth and depth of knowledge that is required, to make these operations run smoothly. There is a reason Amateur Radio operators are often asked to solve problems that are not strictly communications or at least Amateur Radio communications. Our role depended upon the following key elements of knowledge and expertise: Amateur Radio Emergency Data Network mesh software; DHCP server and VLAN switch configuration; propagation at UHF and SHF frequencies and likely IMD and RF congestion issues; ac mains and 12 V dc power systems including battery backups; VoIP phone and Asterisk AllStar switch configuration; data, RF, and power cable fabrication; portable field deployment under unstable conditions skills; unit and system testing; packaging and logistics; effective interpersonal and written communication, and finally, leadership skills.

In order to make this happen, we kept a full set of documentation of the end user requirements, our evolving plans, assumptions, and status. These kept us from failing from an organizational viewpoint, but it was the folks who contributed to the effort with their expertise, equipment, and time who made the difference. We would be happy to help anyone with the planning of their event, so feel free to ask!

Photos by the author.

Gordon Beattie, W2TTT (ex-N2DSY, WB2CAM), was first licensed as WN2CAM in 1975. As a longtime innovator with over 59 US patents, he has been interested in Amateur Radio since high school, and has now been in the communications field for over 40 years, currently working as a principal systems engineer. He is interested in digital modes, public service, and VHF+ weak signal and FM activities. He and his wife, Nancy, N2FWI, are both ARRL Life Members, and he is heavily involved with Boy Scouts of America because of his three Eagle Scout sons, James, KC2SQV; John, KC2NZC, and Jeremy, KC2VBS. Gordon can be reached at **w2ttt@att.net** or **w2ttt@att.com**.