Dedicated Volunteers Enable Public Safety at Swallows Day Parade

The Swallows Day Parade in San Juan Capistrano, California is, according to its organizers, the largest non-motorized parade in the United States. Hundreds of volunteers worked with local officials to maintain public safety among the estimated 35,000 people who attended the 57th annual event.

To support the unique communications needs that go beyond the normal capacity of the public agencies, a small team of FCC-licensed amateur radio operators who belong to the Radio Amateur Civil Emergency Service (RACES) provided specialized communication services.

The local Tri-Cities RACES (San Juan Capistrano, San Clemente, and Dana Point) and San Juan Capistrano Community Emergency Response Teams (CERT) have actively supported city events for many years. For example, Joe Lopez, W6BGR, Chief Radio Officer demonstrated Amateur Radio Emergency Data Network (AREDN™) technology deploying four IP cameras to the Annual Tree Lighting Celebration in December 2014. The Sheriff's Department leadership noticed the capability, which lead to a closer partnership and the integration of all of these resources into the command center for the Swallows Day Parade, the city's biggest annual event.

The RACES team developed a plan to provide real-time video camera coverage of the parade route to support the Sheriff's department and emergency response agencies. The plan called for deploying an AREDN mesh network consisting of radio communication links and IP cameras. The AREDN project mission is to provide the Amateur Radio Community with a quality solution for supporting the needs for high speed data transfer in Amateur Radio and Emergency Communications.

Orange County Sheriff's Administrative Sgt. Joseph Cope noted that "This mesh camera system provided by RACES members was a very valuable tool for our command staff. As we were taking the calls, we could see the activity taking place in real time." In a meeting with city staff, he also stated, "The parade was the safest in years. Incredibly, there was only one arrest for fighting, which just happened to take place in the cameras view." There were two incidences where an ambulance response was needed. Each situation occurred in proximity to an IP camera, enabling the incident commanders to observe them in real time.

The parade cameras sent images across the radio network to the Orange County Sheriff's Department state-of-the-art Mobile Command Center (MCC). This MCC is a semi-tractor trailer with generated power and patch panels for video, data, and radio needs, including more than a dozen high-definition monitors positioned both internally and externally.

This quick deployment of a high-speed video data network provided valuable knowledge that both the RACES team and the public agencies can apply to future events and critical emergencies.

Figure 1

Mobile Command main work center with AREDN video, RACES net control, and Sherriff Command

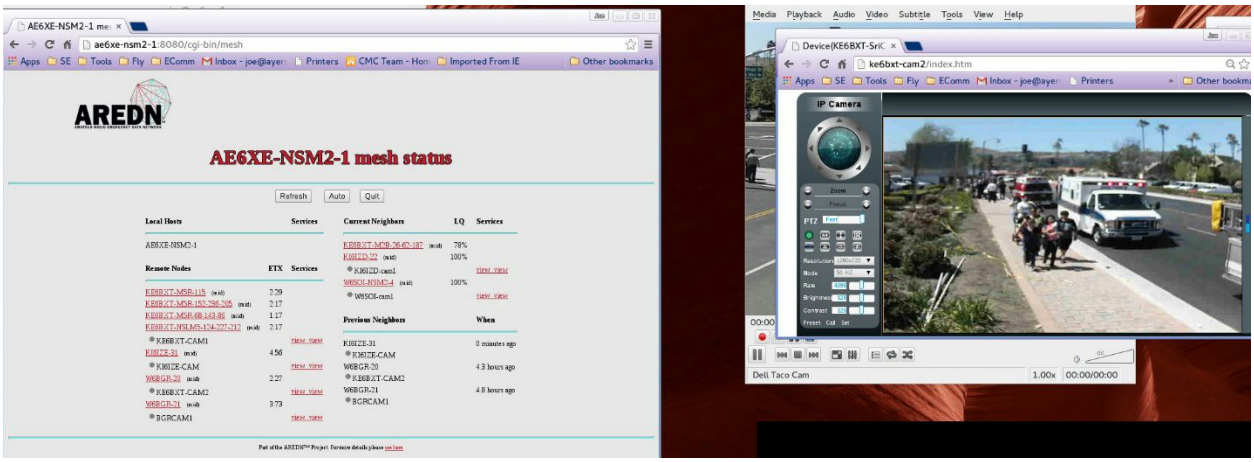

Figure 2

As observed from the Mobile Command Center, ambulances and EMTs assisted a woman unconscious on the sidewalk from Station G

Figure 3

From left to right: AREDN video feeds, WA6BJY RACES Net Control, CERT, San Juan Capistrano Chief of Police Lt. Scott Spalding in main work center of Command vehicle

Deploying AREDN

This article describes the details of how to build an AREDN™ network similar to the one successfully deployed by Tri-Cities Radio Amateur Civil Emergency Services (RACES) to support the City of San Juan Capistrano, California's annual Swallows Day parade. This configuration could be used to monitor events or emergency instances in almost any setting.

This configuration included six IP cameras positioned across the downtown area to provide live video to the Mobile Command Center (MCC). The Sheriff Department's Command and Dispatch Center monitored the video feeds enabling "extremely valuable" direct visual situational awareness of the event.

AREDN-RACES-CERT-Sheriff Partnership

The Tri-Cities (San Juan Capistrano, San Clemente, and Dana Point) RACES and San Juan Capistrano Community Emergency Response Team (CERT) have actively supported city events for many years. Joe Lopez, W6BGR, Chief Radio Officer, previously took an interest in BroadBand-HamNet™ (BBHN) and its successor, AREDN focusing on emergency communications. This interest lead to a demonstration of four IP cameras deployed to the San Juan Capistrano Annual Tree Lighting Celebration in December 2014. This introduced the Sheriff's Department leadership to the capability, which resulted in a closer partnership and further integration of all of these resources into the command center for the Swallows Day Parade, the city's biggest annual event.

Equipment

The equipment used consisted of several Ubiquiti 5 GHz and 2.4 GHz AirMax 802.11 devices and antenna options. A typical station setup included:

- 10' pole or taller extension poles where height may be an important factor to achieve line of sight links.
- Clamp-on IP Cameras (ipCam) configured with single POE (Power over Ethernet) cat5 cable for both network and power connections.
- One (or two for relay station) Ubiquiti nodes with antenna choice for coverage area necessary at a given location.
- Power source for each device.
- Miscellaneous cat5 cables, power connectors, passive POE splitters, and Ubiquiti power bricks.
- Small network switch for three network connections in "relay" stations with enclosure.

In the San Juan Capistrano setting, the downtown coverage area is within a square-mile area with numerous trees and two-story buildings. The primary consideration was how to design the aggregation of video streams to ensure sufficient bandwidth for smooth streaming video into the command center. Dual-channel antennas were selected to maximize data throughput. High-gain antennas (e.g., large grid dishes) were not selected because of the close-in distance and the unwanted attention they would attract.

The stations were set up by selecting the Ubiquiti node(s), Antenna, and ipCam for rapid clamp on and assembly. By maintaining an inventory of these "building blocks" for future use, a station can be instantly assembled to meet the needs of a given situation.

Figure 4

The W6SOI AREDN "Ruby's" Station B with ipCam and Ubiquiti NanoSation M2 positioned over key intersection and across the street from the 'Swallows Bar', a known hot spot

ipCam Configuration

The ipCams in use were high-definition 720p from SriCam with PTZ (Pan-Tilt-Zoom) capability. (A special note for the generous contribution of Don Hill, KE6BXT from Mission Viejo RACES, for his time and loan of four of these ipCams and several Ubiquiti nodes.)

The mounting configuration included the following parts:

- Medical device clamp (found at a local swap meet)
- Electrical box (from local hardware store) with choice of several sizes
- Passive POE splitter (from numerous online sources)

Be sure to carefully confirm that all devices receive proper power. For example, the Sricam model we used will not function if plugged into higher voltages (e.g., from the Ubiquiti 24v power bricks).

Figure 5

ipCam with clamp on mount

Switch Box

A switch is required when three or more devices are connected at a given station. This allows for multiple ipCams at a station, and also enables multiple AREDN nodes.

This configuration relieves contention for frequency space. Rather than a single node spending 50 percent of the time receiving data and 50 percent of the time sending data, two nodes allows one node to spend 100 percent of the time receiving data, and the other to spend 100 percent of the time sending data. The two nodes must be on different bands or separate channels to relieve frequency contention. Data is automatically routed over a cat5 cable through the switch between the nodes with the Device-to-Device Link (DtDLink) capability built into AREDN.

The preferred switch is one compatible with 802.1q or VLAN capability. The NetGear GS105E switch is frequently used with VLAN capability. This “smart” switch can be configured to segment packets between designated nodes and devices. This enables an ipCam plugged into the switch to communicate only with the one node the switch is configured to talk to.

When a “dumb” switch is in use, all the devices plugged in see all packets from all other devices. This requires special settings on the AREDN nodes—only one node should have the LAN DHCP turned on (a box checked in basic setup). When multiple nodes have the LAN DHCP turned on, the ipCam may receive an IP address from any of the nodes. It’s inevitable that the ipCam will not receive an IP address from, and be able to, talk to the node preconfigured to advertise the ipCam across the network. Thus, when using a “dumb” switch, this extra step to turn off LAN DHCP on all but one node is necessary.

While the switch could be mounted in the open, a weather-proof enclosure is recommended.

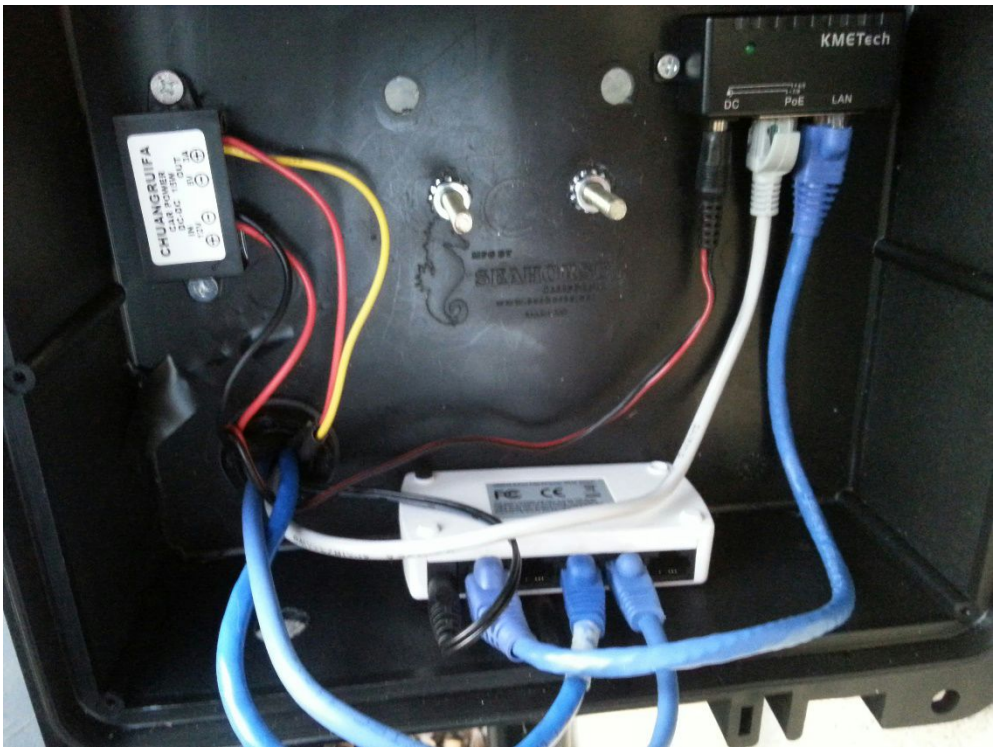

Figure 6

"Dumb" switch connecting two Ubiquiti nodes and one ipCam in weather proof enclosure (two passive POE splitters not shown in this picture)

Mobile Command Center

The Orange County Sheriff's Department sustains two state-of-the-art Mobile Command Centers. These semi-tractor trailer trucks are complete with generated power and patch panels for video, data, and RF needs. Over a dozen HD monitors are positioned throughout the vehicle internally and externally. There are 3 sections in the vehicle:

- Main work center for Incident Command, Logistics, Finance, and Media Relations
- Command Office
- Technology Center (patch panels, generator control, etc.)

Figure 7

AREDN video feeds shown in the Sheriff's Dispatch Center (Command Office). Selected video feeds can be shown on any monitor in the truck.

Network Design

The downtown area of San Juan Capistrano included numerous vendors with tents setup in areas not on the direct parade route. Trees upwards of 60’ and heavy foliage encased all green areas. The network design relied on line of sight down the streets with two strings of three nodes each and respective ipCams, making six total ipCams. Refer to Figure 8 of the Google map showing station locations with the respective frequencies in use.

The video stream was combined and forwarded at relay nodes. For example, the video from Stations G and H were combined with the video stream at Station F, and then transmitted to Station E.

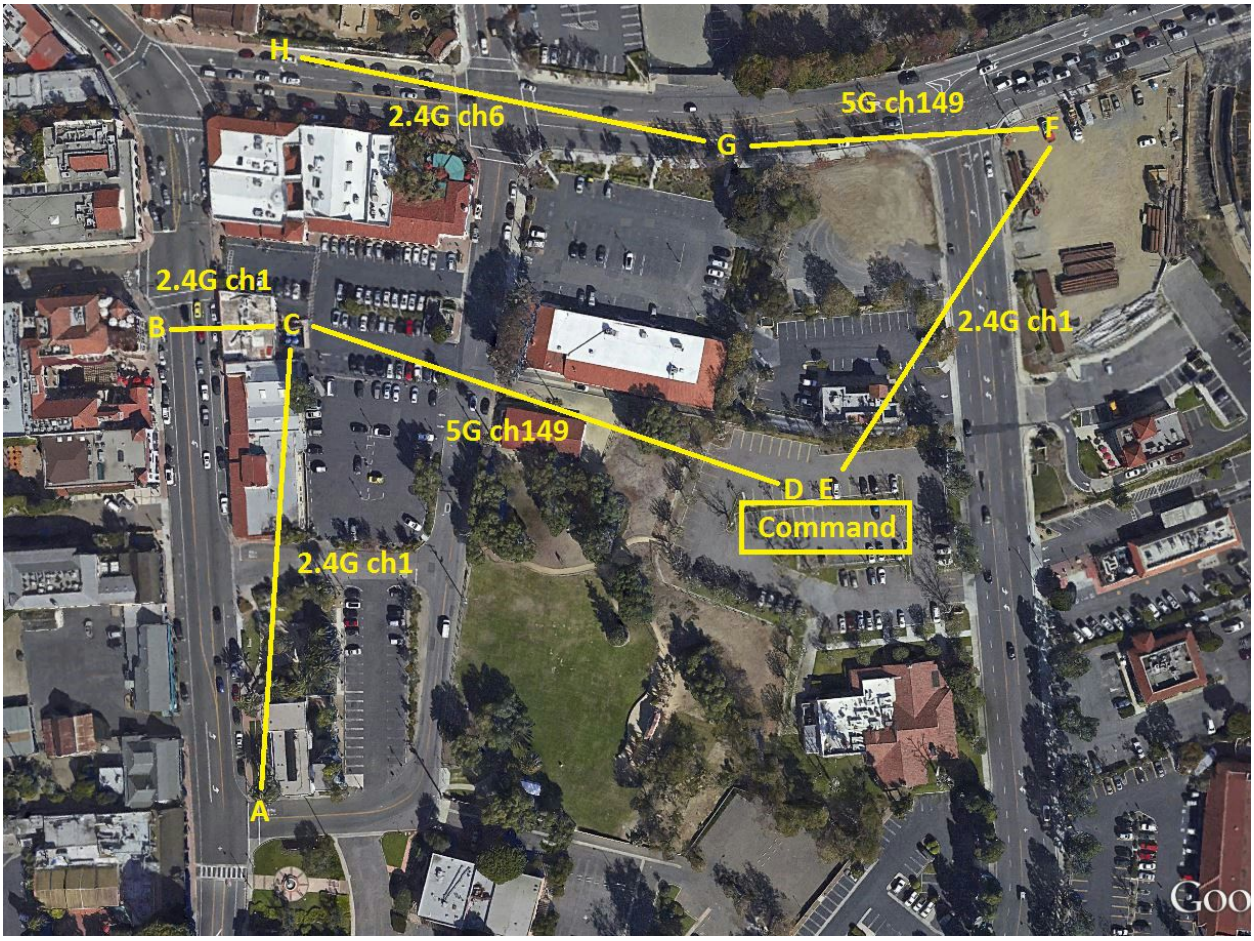

Figure 8

Station locations and path frequencies

Figure 9

KE7EYT and W6BCH Station C with Rocket M5 and Bullet M2 relay

Figure 10

The KJ6IZE "Adobe" Station A with NanoStation M2 and hitch mount across the street from the Adobe Bar, another after party location

Figure 11 shows the command vehicle external network patch panel, which was located just inside an easily-accessible right rear side compartment. After connecting two 25' cat5 cables, the Ubiquiti nodes were set up on a tripod in the parking lot. A network patch panel in the vehicle technology center connected the nodes to laptops at the main work center table. An opening below the tree foliage enabled line of site to the neighbor nodes.

Figure 11

2.4Ghz NanoStation Station D and 5Ghz Rocket Station E with dual channel flat panel antenna receiving video streams from two strings of ipCams across the San Juan Capistrano downtown parade route

Lessons Learned

The setup and environment enabled high-quality video streams for five of the six ipCams. The video streams were smooth throughout the day for the five cams. There were several lessons learned:

- The environment can be unpredictable. Station A was unable to stream video through line-of-sight to Stations B or C with over 35 SNR signals from those stations. However, to our surprise, Station A was able to stream lower quality video directly to Station E (a NanoStation with sector antenna pointing in the opposite direction and heavy tree foliage blocking the path).
- Four high-quality video streams can be successfully received through a single node. In this case, through Station E, a NanoStation M2 with a dual channel antenna.
- Know your equipment. The ipCams were relatively new. Sheriff's Department personnel made several requests to position, zoom, and focus the cameras. There were two fights, one arrest, and ambulances assisted two incidences. In each situation, the activity occurred in proximity to an ipCam and was keenly observed by commanders. Our ability to manipulate the cameras and keep images in focus had room for improvement.

- Prepare to maintain performance. One of our laptops was under-powered to handle the multiple HD video streams. This caused adondditional delay to remote control of the ipCams.
- Determine the video quality that is actually needed. 720p HD quality video was sustained for the event. A lower quality video stream may still be sufficient.

A follow up review with the Sheriff's Department is scheduled to discuss a long-term plan and improvements for future events. They viewed the video service as "Extremely valuable," and that it is part of "the future of police activity."

Summary

The event was enjoyed by all and allowed many of us to sit in the Command Center in a prominent role for the first time. We all look forward to expanding our capabilities for the next event.

Tri-Cities RACES
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W6SOI Phil Greenberg
KI6IZD Drew Holtz
KI6IZE Clark Croisette
WA6BJY Gray Bickford

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