After Action Report: WiFi/Mesh Activity County-wide Drill – 18-Apr-2015

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Event Details

- Activation Number: XSC-15-04T
- Date: April 18, 2015
- Location: Ed Levin County Park, Milpitas, CA
- Times:
    - Drill: 08:00 – 13:00
    - Staff: 06:00 – 14:00
- Staff team:
    - Michael Fox, N6MEF
    - Jim Oberhofer, KN6PE
- Goals
    - Provide a meaningful and fun experience for drill participants
        - Let them experience a variety of capabilities that are possible with a mesh network in the field
        - Provide them with ideas they can use to develop service offerings within their own cities
    - Gain better understanding of WiFi/Mesh deployment issues
        - Learn what it takes to build and operate the network at an ad hoc activity/location
        - Learn what it takes to support drill participants
- Staff prep time: Total = 304 hrs
    - Michael Fox: Total = 200 hrs
        - Drill-specific: 40 hrs
            - Prepare drill scenario
            - Configure, test, pre-stage network
        - Pre-drill general prep, experimentation and documentation: 150 hrs
            - Experiment and document field battery power configurations
            - Build four field battery power boxes
            - Experiment and document direct node-to-node linking
            - WiFi/Mesh workshop prep and execution
        - Post-drill activities: 10 hrs
            - Separate and store all deployed equipment
            - Documentation, web-site updates
    - Jim Oberhofer: Total = 104 hrs
        - Drill-specific: 15 hrs

        - Prepare drill-specific servers and content
        - Prepare specific how-to documentation
    - Pre-drill general prep, experimentation and documentation: 85 hrs
        - Server experimentation and configuration
        - WiFi/Mesh workshop prep and execution
        - BBHN Client Handbook prep
    - Post-drill activities: 4 hrs
        - Documentation
- Participants:
    - Six participants; total time = 11.8 hours
- Feedback:
    - Drill feedback form: Two people commented that they liked the mesh activity. There were no negative comments about the mesh activity.
    - scc-mesh Yahoo group: Three people made positive comments about the mesh activity. There were no negative comments.

Educational Approach

WiFi / Mesh networking is new to most Santa Clara County ARES/RACES participants. So this activity was designed to be mostly educational, rather than one that put into practice pre-existing equipment and years of prior experience. The following unique activities were performed prior to the drill.

WiFi / Mesh Workshop

A workshop was conducted in March to help prepare potential drill participants with the knowledge they would need to perform well at the drill. The workshop was also intended to make the activity seem less imposing to brand new users who might otherwise not want to try it in a drill setting.

The workshop was developed and conducted by Jim Oberhofer, including the presentation, all exercises, handouts and workbooks. Michael Fox, Tim Howard, Logan Zintsmaster, Don Clendenin, Judy Halchin and Allan Gontang provided support such as location and prep of the venue, preparing and supplying equipment, setup/tear-down, as well as technical support during the workshop. The workshop was attended by 37 people, including 6 staff.

Instructional Documentation

Experimentation was performed on how to deploy and operate a field station. The information learned was then documented and posted to help all users to build and operate a station. The following documentation was prepared and posted to the county ARES/RACES website.

Power Options for Field WiFi Stations

Documents a variety of battery power configurations to support Linksys and Ubiquiti radios, plus phones, cameras and other devices. Includes experimental test results for voltage, current, and extrapolated runtime.

Device-to-Device Linking with BBHN Software and Ubiquiti Radios

Explains how to link multiple Ubiquiti radios at a single site via the LAN. Such a configuration would be used when multiple sectors or multiple bands are in use. The drill exercised the multi-band configuration.

BBHN Client Handbook

A step-by-step how-to guide to a variety of client functions, including: mesh node setup, phone setup, web site access, web cam access, anonymous FTP server access, HamChat access, network file share access.

Lessons Learned

The following list of lessons learned is in no particular order. Some items may seem obvious to the experienced operator but are included in order to help newer operators.

Schedule

- The schedule called for staff to arrive at 06:00 and the drill to start at 08:00. Two hours is about the right amount of time to set up nodes at multiple sites and resolve any last minute problems that might occur. Some installation was delayed due to staff in several locations arriving late. And there was an initial problem with RF power levels and phone passwords. These were resolved by 08:30, one half hour later than desired.
- Set up time could be reduced if:
    - All staff shows up at the agreed-upon time so that waiting time is eliminated
    - Each location handles set up of its own node so that: a) time to travel between and move equipment to each site is eliminated, b) set up can be done in parallel at all sites, and c) testing is more easily performed with a person on each end of all links.

Pre-staging

- The network and server access were pre-staged several days in advance of the drill in order to flesh out the steps in the assignment briefing. The pre-staging was helpful and did uncover some glitches in procedures.

Assignment Documentation

- Attendees were given a specific assignment briefing and a separate handbook of how-to information. This worked well because it kept the assignment clear and concise and it allowed the handbook to be produced in a more general format that can be used for any deployment.

Radios

- Start at full power; adjust down if desired
    - The radios were initially started at their minimum power levels of about 11-13 dBm, depending on the model. Initially, some of the links didn't come up. Due to lack of time, power was boosted to full power to make sure the net was operational in time for the event start time. More investigation into ideal power levels should be conducted.
- Ubiquiti is best for "field" use, not indoor

  - The weather resistant form factor makes Ubiquiti a good choice for the "field" radio, i.e. the radio used at each site. It can easily be positioned on a tall mast to reduce attenuation by surrounding objects. This also reduces the RF radiation experienced by people in the area.
  - Lack of an Ethernet switch and desktop form factor make it a poor choice for indoor/lab use
- Linksys is best for "indoor" use, not field
  - The lack of weather resistance and the desktop form factor makes Linksys a poor choice for field use. But the desktop form factor, integrated antennas, and integrated Ethernet switch make it ideal for indoor/lab experimentation and testing.
- Dual-polarity / dual-streams can double the bandwidth. But it is unclear how much a dual-polarity radio, such as the Rocket or Nano, adds when operating with the BBHN software and when supporting the anticipated applications. More investigation with the BBHN software developers and more experimentation is needed.

Antennas and antenna supports

- Dual-polarity antennas enable double the bandwidth. But they are very bulky and heavy compared to single polarity antennas. And they require more substantial masts to support them. More investigation and experimentation is needed in order to determine how useful the additional stream can be when using the BBHN software and when supporting the anticipated applications.
- Speaker tripods with PVC extensions were used to support the dual-polarity antennas. Since pop-up tents were used, the tripods were secured to the tent support posts, rather than create a tripping hazard.
- Collapsible painter's poles were used for the single-polarity antennas with Ubiquiti Bullet radios. The poles collapsed to 4 feet but extended to 12 feet to insure RF energy was not focused directly on individuals in the immediate area.

Power

- Four nodes (WiFi-2, WiFi-5, Staging, Field), including radios, Ethernet switches and cameras were run from battery boxes which were developed for that purpose. The boxes delivered 24V unregulated, 24V regulated PoE, 12V regulated, and 5V regulated outputs. Each box contained a pass-through volt meter. The ending voltages confirmed that the run times were consistent with the anticipated run time calculations that have been previously documented. The boxes do not include a built-in charger. Instead, external chargers were used. The boxes worked very well but their construction was tedious.
- The four GOTA (Get On The Air) stations, including Linksys radios and IP phones, were powered by a generator.
- The server laptop and an additional camera were powered by a generator.
- Other stations at Net Control and Packet had their own power setups.
- More experimentation and experience is needed determine an ideal power supply for field stations.

Phones

- The Zulty's Zip 2 phones have no speaker microphone. A two-way speakerphone could be very helpful at a busy location.
- The Zulty's Zip 2 phones have a single line appearance. So either call waiting must be used or the second call must receive a busy signal. But call waiting tones interrupt the call in progress (rather than being heard simultaneously), rendering them almost useless when a second call is incoming. But turning off call waiting means the person being called doesn't know that someone else is trying to reach them. So an existing low priority call can prevent a second, higher priority call from coming in.
- In general, call waiting is not used in business applications. Instead, multiple line appearances are used. Then the person receiving a second call can decide to put the first call on hold and answer the second call (potentially bridging them together, if desired), or not answer the call.
- Phones that support two line appearances would make more sense for actual deployments. A small display that shows the caller ID info would also help to prioritize whether or not to answer a second incoming call. Such a display will draw slightly more power.

Cameras

- Ubiquiti:
    - Good: Weather resistant
    - Good: don't require a browser plug-in
    - Bad: Single login which grants administrative rights. No admin vs. user logins.
    - Bad: Slow frame rate, yielding choppy video
- Foscam indoor pan/tilt camera:
    - Bad: Not weather resistant. Not practical for real field deployment.
    - Bad: requires browser plug-in for all browsers. Plug-in is downloaded from the camera itself, but the process to install the plug-in varies from browser to browser and is not intuitive
- Wanview indoor pan/tilt IP camera:
    - Bad: Not weather resistant. Not practical for real field deployment.
    - Good: no plug-in required for Firefox or Opera browsers
    - Bad: plug-in required for Internet Explorer and other browsers
- General
    - Many/most IP cameras seem to require a plug-in. This is fine for static implementations but troublesome for ad hoc use by multiple "walk-up" users.
    - More investigation into an optimal pan/tilt/(possibly zoom) camera for outdoor use is needed.

Servers

- A single laptop running Ubuntu 14.04 linux was used to run all server functions.
- A laptop is an ideal platform since it incorporates keyboard, mouse and screen into a small, portable package.

IP-PBX/Phone Server

- Asterisk was used to provide the IP PBX function

- More investigation is needed to configure the server to provide downloadable phone configurations so that individual phones don't need to be programmed manually.

Anonymous FTP Server

- Vsftpd was used to provide an anonymous FTP server function
- More experimentation is needed to define the ideal permissions for upload/download

CIFS/Windows File Sharing Server

- SAMBA was used to provide the File Sharing environment

Web Site

- An event website was set up to provide participants with an in-field web browsing experience.
- The website provided specific documentation for download as well as a phonebook listing the functions, names, call signs, and extensions for phones on the network.
- The phonebook was updated by changing the phonebook html page. For a truly dynamic system, a web program should be written to allow users to register their phone number.