ESP Telemetry and Shore Stations

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ESP Buoys
and Shore Station

Freewave 900Mhz
Multipoint SLIP
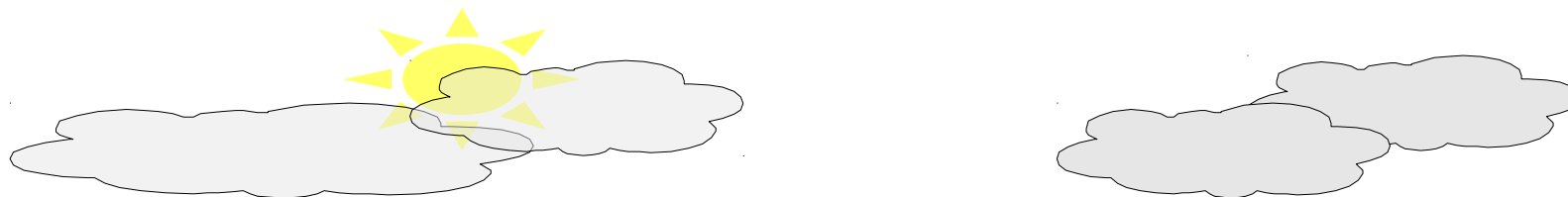
Internet via cable, DSL or
Cellular Modem

Shore
Station

ESP1   ESP2   ESPn

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Freewave Radios
model FGR-115WC

- Unlicensed 900Mhz, up to 1 watt RF output
  - Not legal in much of world outside the Americas

- RS-232 serial interface
  - 115.2 kBits/s – RTS, CTS, and Carrier Detect required
  - Configuration via RS-232 Break or switch in back
    - Configuration menus always at 19.2 kBits/s
    - Lots of arcane settings and modes
      - See CVS: ESP/gen2/software/ppp/freewave.cfg
- ESP originally used Point-to-Point mode with PPP
  - Radios paired by their serial numbers
  - Required changing call books remotely when radio failed

http://www.freewave.com/files/datasheets/FGR115RC_WC%205.14.09.pdf

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Freewave Radios
in point-to-multipoint mode

- ESP now uses point-to-multipoint mode

  – One (master) shore station can support up to many (10+) ESP slaves

  – Slave cannot directly communicate with each other

  – All radios must be set to the same FreqKey and Network ID

  – Downloads from shore to ESPs are much slower as point-to-point

    - Uploads are as fast as point-to-point (~7 Kbytes/s)

  – Uses SLIP to encode ethernet packets in RS-232 serial

    - Serial Line Internet Protocol (rfc1055 circa 1988) works
    - Radios form a point-to-multipoint (party-line) serial network
    - Cannot use Compressed SLIP (CSLIP)
      – because it assumes there are only two endpoints on the link
    - Cannot use new, more common PPP protocol either
      – PPP stands for Point-to-Point Protocol

  – SLIP has no support for dynamically assigning IP addresses

    - Every ESP must have an appropriate, unique address configured before deployment
    - The IP address ranges (i.e. subnets) used may differ between shore stations

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Shore Stations

ESP Shore Server

- Consist of:
  - Vertically polarized Yagi antenna
    - Usually mounted high on poll, pointed to sea
  - Freewave radio strapped on same pole (to minimize RF cable length)
    - All radio connections must be carefully sealed against weather
  - Pictured enclosure is the "ESP shore server", containing:
    - Same Linux host TS-7200 CPU found in each ESP and stand alone MFB
    - One channel serial board (for **COM3 port to Freewave**)
    - Real-Time clock
    - Switched Freewave radio power out
      - on coax *__female__* connector added to back panel by MBARI (not shown)
      - Powered whenever COM3 is opened by a Linux application
  - ***USB, COM1 and COM2 are __not__ normally connected !! (we should cap them)***
    - COM2 is the Linux console, which may be connected for debugging
  - Single (up to 60ft long) cable carries COM3 RS-232 & switched power to Freewave radio
  - ETHernet is connected to the internet via some standard router
    - Details of network configuration are (unfortunately) router dependent

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Shore Station Services

ESP Shore Server

- Shore Stations' FTP sites are live on Internet
  - But use ftp://bufflehead when you can
    - Saves network bandwidth and fees
- SSH access for commanding server & its ESPs

  - Non-standard SSH ports are used

    - To evade marauding password probing 'bots

  - ssh access is easy from bufflehead

    $ ssh sunsetbeach #in watsonville

    $ ssh socal   #in orange county, near Huntington Beach

    $ ssh espscruz   #brent's house in santa cruz

  - Otherwise, one must know the nonstandard port numbers

    - They are in the file /etc/ssh/ssh_config on bufflehead

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Shore Station Services cont'd

ESP Shore Server

- Shore Stations upload each ESP's FTP data near the top of every hour
  - Only new data is uploaded via FTP
    - This scheme is confused if files are not sequentially written
  - Only data from each ESPs top level directory (no hires images)
- Bufflehead uploads FTP data from each shore station near 20 minutes past the top of each hour

  - Force immediate upload from ESPs off socal to bufflehead:

    esp@bufflehead $ ssh socal bin/upload

    esp@bufflehead $ uploadStations

  - Files appear under /ESP/station or ftp://bufflehead/ESP/station
  - Bufflehead's ftp site & /ESP share only accessible inside MBARI

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How do a upload a hires image?

ESP Shore Server

- Do this at about 30 minutes past the hour
- From a Linux prompt on the shore station:

    $ cd /var/log/espName/esp

    $ mkdir hires   #if the directory does not already exist

    $ cd hires

    $ wget ftp://espName.radio/esp/hires/*file.tif*

- This will get the file up to the nearest shore station
- Bufflehead will upload it at 20 minutes past the top of the next hour
- Could create a script to run called fetch to run on shore station: ??

    $ fetch espName.radio/esp/hires/file.tif

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Accessing deployed ESPs via Shore Stations

- All access to deployed ESPs outside the MBARI network is via ssh to its Shore Station

- Step 1:   ssh to the shore station as described in previous slide

- Step 2:   Telnet to desired ESP

  - The telnet connection will connect much faster than ssh would
  - Tenet session is in the ssh tunnel to the shore station, so it's secure

- Example of establishing an ESP client session with ESPmack off ESP-SoCal.endofinternet.org:

  bufflehead $ ssh esp@socal   #opens secure session over internet

  esp@ESP-socal$ telnet ESPmack.radio   #opens session via FreeWave

  - You will be prompted for appropriate username and password

  esp@ESPmack$ espclient *myName* #finally talking to the ESP app

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Email Tunneling Overview

- ESPs send email via Simple Mail Transfer Protocol (SMTP)
- SMTP is an old, ubiquitous, insecure protocol

  – Great for propagating SPAM !!

  – MBARI's mail servers will not accept it from outside sources

  – Tunneling makes ESP mails look like they come from within MBARI

- Bufflehead maintains ssh sessions with each shore station

  – These forward the stations' SMTP port (#25) to that of mail.shore.mbari.org

  – It's tricky to keep the tunnels from collapsing

    - Routers want to break these "idle" connections
    - Occasional "keep-alive" traffic avoids this
    - Also need to kill zombie forwarding processes on stations

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Email Tunneling:
Starting, Stopping & Testing

- To start Email tunneling, as user esp on bufflehead:
  esp@bufflehead $ tunnelESPmail

- To stop Email tunneling, as user esp on bufflehead:

  esp@bufflehead $ tunnelESPmail stop

- To test Email tunneling, as any user on a shore station:

  esp@ESPsunset:~$ telnet mail smtp

  220 snow.shore.mbari.org MBARI Mail Service ...

  #Success! Press Control-C to exit from telnet and dance a jig

- If telnet reports "connection refused", email forwarding not working

  - On bufflehead, check logs with:

    esp@bufflehead $ tail -F /var/log/esp/*tunnel*.out

  - Rerun tunnelESPmail, reboot shore station, ...

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Preparing
Shore Stations for Deployment

- Each shore station uploads from ESPs serviced by it
  - ESP's serviced are /var/log/ESP*

  - ESP*.radio is often a symlink to esp*name*

  - Top level ESP*.radio directories are "seeded" with subdirs and files to upload:

    - Typically the subdirectory "esp" and the file "messages"

    - First, archive any old data you want to keep

    - Just before deployment, for each ESPname:

          root@...$ > /var/log/messages #truncate kernel log

    - As user esp:

          esp@...$ cd /var/log/ESPname
          esp@...$ rm -rf *   #remove all previously uploaded data
          esp@...$ mkdir esp
          esp@...$ > messages #truncate copy of ESPname's kernel log
          esp@...$ rm /var/log/esp/upload.out #remove old upload log

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Preparing
Bufflehead for Deployments

- Bufflehead uploads from all MBARI's ESP shore stations in use
  - ESP's serviced are /var/log/ESP/station/*
  - Top level station directories are "seeded" with subdirs listing ESPs

    from each to upload:

    - One subdirectory for each ESP deployed off that station
    - First archive any old data you want to keep
    - Just before deployment, for each shore station:

        esp@...$ cd /var/log/ESP/station/*stationHostName*
        esp@...$ rm -rf *
        esp@...$ mkdir *espName1 espName2 espNameN*
      - Where espNameN is a name of an esp off this station:
        - » espbruce, espmack, etc.
      - The espNames must match those in the station's top FTP directory
        - » ESPbruce.radio, ESPmack.radio, etc. would work just as well
  - Remove old uploadStations log:

      $ rm /var/log/esp/uploadStations.out

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Preparing
ESPs for uploading to shore

- Each ESP's FTP site is based at /var/log
  - /var/log/messages (kernel messages) should be emptied
  - /var/log/esp should be emptied after archiving elsewhere

    root@ESPname # cd /var/log

    root@ESPname # > messages #do not rm this file!

    - If you do, reboot or:

      # service syslog restart
    - As User esp:

    esp@ESPname $ rm -rf /var/log/esp/*

- ESPs and Shore Stations Real-Time clocks are not sync'd to network time

  - They drift a couple minutes a month, set them, as root user, with:

    root@espName # date -s HH:MM #or YYYY.MM.DD-HH:MM

    root@espName # hwclock -uw   #RTC is kept in UTC

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Starting (& Stopping) Hourly Uploads of ESPs from shore stations

- Each shore station uploads every hour from its ESP moorings
  - This process must be manually started after each reboot

  - Do this from each station's esp user's account (not root)

    esp@station $ start hourly upload

  - To stop uploads:

    esp@station $ killall -q hourly sleep upload wget

  - You most stop uploads per above before re-starting them

  - Rebooting the shore station is another way to stop uploads
    - Not a bad idea at the end of a deployment

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Starting (& Stopping) Hourly Uploads Shore Stations from Bufflehead

- Bufflehead uploads from each shore station 20 minutes past top of each hour
  - This process must be manually started after each reboot
  - Do this from Bufflehead's esp user's account (not root)

    esp@bufflehead $ uploadHourly

  - To stop uploads:

    esp@bufflehead $ killall -gw hourly

  - You most stop uploads per above before re-starting them

      esp@bufflehead $ ps -fUesp #will display relevant process info
    - Look for an "hourly uploadStations" process in the ps command's output
  - Don't even think about rebooting bufflehead :-)
    - It's been up for 258 days
- But, I want to upload 30 minutes past top of each hour!

    esp@bufflehead $ killall -gw hourly #incase you were already uploading

    esp@bufflehead $ minute=30 uploadHourly   #et viola!

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Shore Station at Sunset Beach ftp://SunsetBeach.endofinternet.org

- At 36 Sunset Beach Drive, Watsonville, CA
  - On roof of house on cliff 100+ ft above the beach (with a great view!)

  - We pay homeowner, Abe Novin, $599/yr

- His Linksys router is configured to pass FTP and SSH traffic to our shore server

  - We access his router's setup pages via Freewave radio link from MBARI

- We use the free dynamic DNS server at dyndns.com

  - To map his varying IP address assigned by ComCast

    - To the hostname of: SunsetBeach.endofinternet.org

- This ESP shore server has a fixed local IP address of 192.168.1.20

  - Each ESP mooring off SunsetBeach must be preconfigured with

    a unique IP address between 192.168.1.16 and 192.168.1.31

  - Those ESP mooring ↔ IP address mappings can be viewed at:

    - ftp://SunsetBeach.endofinternet.org/etc/hosts

  - Edit /var/log/etc/hosts and /etc/sysconfig/ifcfg-eth0 to change these

  - ESPs last deployed elsewhere may need to have their IP addresses modified

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Shore Station in Santa Cruz ftp://brent.homeunix.org:2121

- At 425 Clinton Street, Santa Cruz, CA
  - Strapped to the chimney of my house 0.3miles from the Seabright Beach
- MBARI shares my DSL internet & existing Linksys wi-fi router running OpenWRT
- The router is configured to pass FTP and SSH traffic to the shore server
  - MBARI assesses this router's setup pages only via me :-)
- I use the free dynamic DNS server at dyndns.com
  - To map my varying IP address assigned by DSLextreme
    - To the hostname of: brent.homeunix.org
- The server has a fixed local IP address of 192.168.8.20
  - All the ESP slaves must be configured with IP addresses between
    - 192.168.8.16 and 192.168.8.31
  - Those ESP mooring ↔ IP address mappings can be viewed at:
    - ftp://brent.homeunix.org:2121/etc/hosts
  - Edit just the file /etc/sysconfig/ifcfg-sl0 to change these mappings
  - ESPs being deployed off Santa Cruz *must* have their IP addresses modified
    - Edit the file /etc/sysconfig/ifcfg-sl0 to change them from 192.168.1.x to 192.168.8.x
    - Change them back before deploying off SunsetBeach or ESP-SoCal

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Shore Station in Orange County, CA ftp://ESP-SoCal.endofinternet.org

- At Orange County Sanitation District between Huntington and Newport beaches
  - On roof of 50 ft high building overlooking settling ponds and beaches
  - Server is mounted in a weatherproof plastic box at base of 15 foot antenna tower
- A Verizon EVDO cellular modem provides internet access via a Cradlepoint MBR900 router
  - http://www.cradlepoint.com/support/mbr900
  - Service costs $60/month for up to 5GB, $40/month for up to 250MB
- Access router's setup pages remotely via secure http site
  - It is OK to Reboot the router in the Tools/System menu
    - Other changes may break remote access – have a plane ticket handy ;-)
- This ESP shore server has a fixed local IP address of 192.168.1.20
  - Each ESP mooring off ESP-SoCal must be preconfigured with
    a unique IP address between 192.168.1.16 and 192.168.1.31
  - Those ESP mooring ↔ IP address mappings can be viewed at:
    - ftp://esp-socal.endofinternet.org/etc/hosts
  - Edit /var/log/etc/hosts and /etc/sysconfig/ifcfg-eth0 to change these
  - ESPs last deployed elsewhere may need to have their IP addresses modified

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