ESP Comms Overview
For User Summit

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ESP Communication Ports

- Each ESP is manually assigned a unique hostname
  - ESPxxx where xxx is either a unique name or serial number
- They will also be assigned unique IP addresses for each network port
  - One for ethernet, another for a radio link, etc.
- The RS-232 serial “console port”
  - Provides direct access without a network
  - Used mainly for debugging initial ethernet networking problems
  - Requires a special serial cable and,
  - With newer computers, a USB<->RS-232 serial dongle

ESP Comms in the Lab

- Wired Ethernet
  - If available, ESP uses DHCP = Dynamic Host Configuration Protocol
    - To automatically get its IP address from network
  - and DDNS = Dynamic DNS (Domain Name System)
    - To register its hostname on that network
- Most labs networks support DHCP
  - but some don't support DDNS
- Each ESP needs a DNS entry so you can access it by its ESPxxx hostname
- Your network administrator will usually be able to provide these services
  - Otherwise, you must assign each ESPs a unique “static” IP address
    - And change them whenever they are moved to a new network
- Wireless ethernet is not directly supported by the ESP
  - However, we have, and you may, plug ESPs into wireless routers.

ESP Network Services
FTP

- FTP = File Transfer Protocol
  - Fetch any data file generated
  - From most web browsers:
    - ftp://ESPxxx
    - Safari users should consider 3rd party FTP browsers
      - Like Cyberduck, or FileZilla
        - These tools also facilitate updating files
        - **NEVER** use the Mac's "Finder" to access ESPs
  - No log in is required to read files
    - Username and password are required to change files
- FTP is the basis for more sophisticated GUI tools

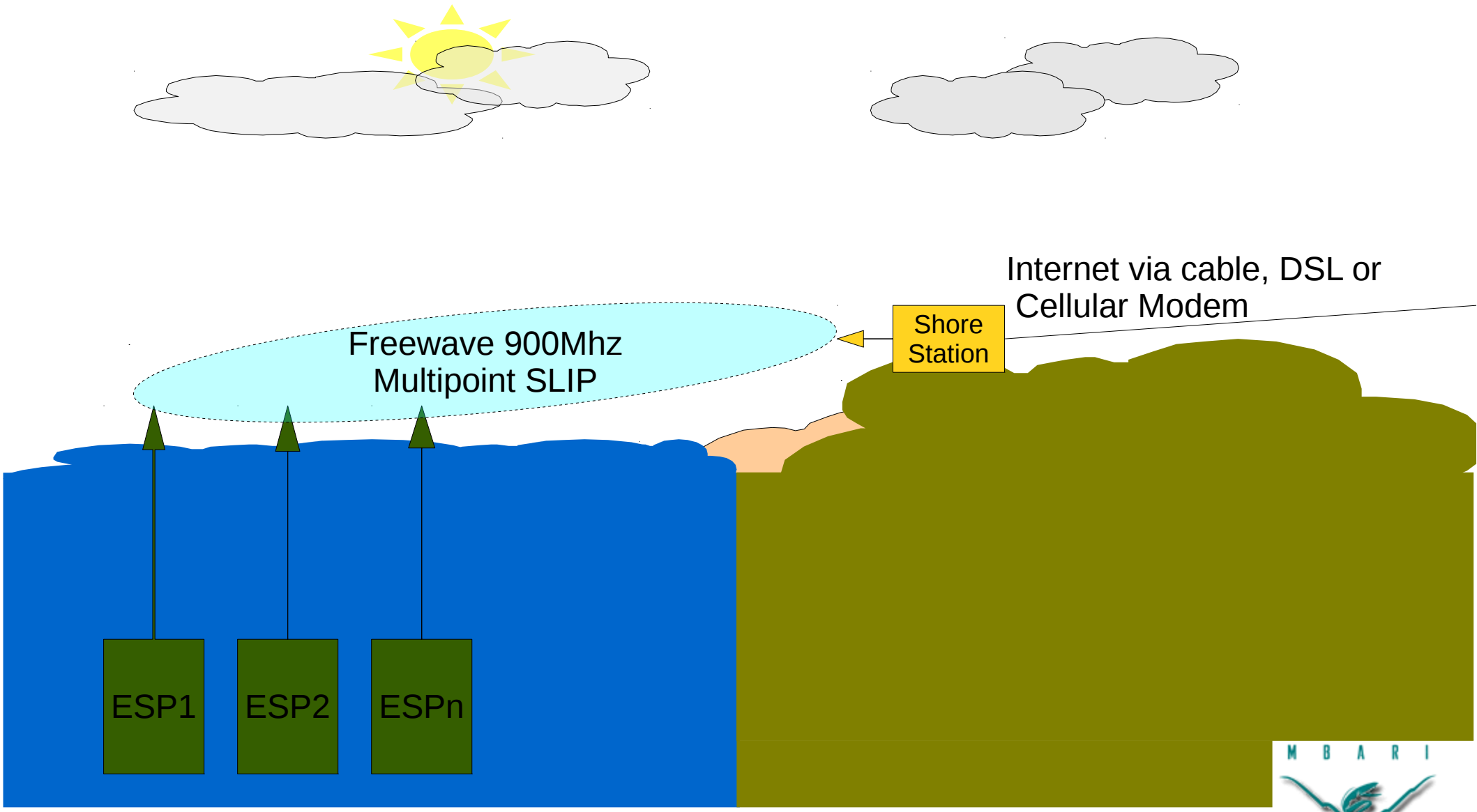
ESP Network Services SSH

- SSH = Secure SHell
  - Multiple, simultaneous secure interactive sessions
    - From which you may “drive” the ESP
  - Also supports:
    - File Transfer (like FTP)
      - Primarily for sending and updating scripts
    - Remote command execution
  - Can be configured with secure keys
    - To login securely without password prompts
  - Client support built-in to Linux and Mac Osx
    - Windows support via readily available freeware

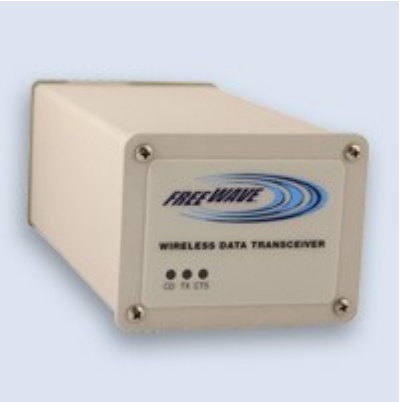
ESP Network Services Telnet

- Telnet is a 50 year old insecure protocol
  - only for interactive “terminal” sessions
  - Client support built-in to every OS
  - Must log in each time with user and password
    - Passwords are transmitted insecurely
      - They may be readily “snooped” off the network
  - Less “chatty” than SSH
    - Better for low-bandwidth or high latency links

ESP Buoys
and a Shore Station



Freewave Radios
model FGR-115WC



- Unlicensed 900Mhz, up to 1 watt RF output
  - Not legal in some parts of world outside the Americas
- RS-232 serial interface
  - Lots of arcane settings and modes
- Relatively slow data rate
  - Max. (with strong signal) = 7 kilobytes/second
  - An ESP image file is typically 750 kilobytes
- Six mile range typical of well sited shore stations
  - Main factor is antenna elevation on shore
    - High and close to shore is best
  - 60 mile range possible (with directional antennas ;-)

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

MBARI

Shore Stations

- 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 an “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
  - 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

Shore Station Services

- 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)
  - Mirrors each of the deployed ESPs

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

Email Tunneling Overview

- ESPs send email via Simple Mail Transfer Protocol (SMTP)
- SMTP is an old, ubiquitous, insecure protocol
  - Great for propagating SPAM !!
  - Most mail servers will not accept it from outside sources
  - SSH Tunneling can make deployed ESP mails look like they are local
- Some server within lab maintains ssh sessions with each shore station
  - These forward the stations' SMTP port (#25) to that of your local mail server
  - 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

Shore Station at Sunset Beach

- At 36 Sunset Beach Drive, Watsonville, CA
  - On roof of house on cliff 100+ ft above the beach
  - with a great view!
- His Linksys router is configured to pass FTP and SSH traffic to our shore server
- We use the free (DDNS) Dynamic DNS server at dyndns.com
  - To map his varying IP address assigned by ComCast
    - To a fixed, known hostname

Shore Station in Santa Cruz

- 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
- I also use the free dynamic DNS server at dyndns.com

Shore Station at New Hampshire Seacoast Science Center

- In a tiny equipment closet at
  - http://www.seacoastsciencecenter.org/
- Antenna mounted on the roof
  - Only about 20ft above sea
  - Provided slow, but reliable 5 mile link
- Supported WHOI's first ESP deployment in Golf of Maine
- Sci Center internet provider needed to configure their firewall
  - to WHOI access to shore station via SSH and FTP protocols
- Again, used the free dynamic DNS server at dyndns.com
  - To map their static IP address to a hostname we could remember

Shore Station in Orange County, CA

- 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 ;-)

Open Ocean ESP