# HAM RADIO WITHOUT A RADIO

*A Slide Show Presentation By:*

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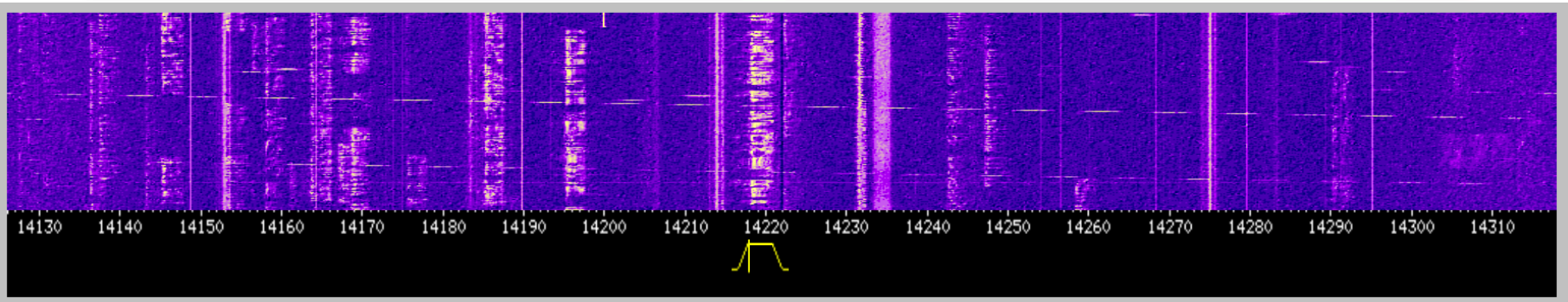
# Software-Defined Radio on the WWW

- WebSDR – Web server interface to computer wired with a software/hardware transceiver
  - Graphical display of hard analog dials/controls
    - Imagine an HF transceiver defined as HTML <form>
  - Digital waterfall visualization of nearby signals
    - Image stream is PPM pixmap format (form of bitmap)
    - Audio stream is an A-law "companded" PCM format
    - Multiple users can tune to different frequencies
      - Unlike typical one-user only web-based EMS scanners
  - Not a CGI-BIN script; WebSDR *is* the web service
    - Browser maintains a half dozen or so persistent HTTP/1.1 connections, each one responsible for: audio, video, tuning, chatbox, logbook, status of other users (band, callsign, IP), etc.

# What's Required to work a WebSDR?

- Very few prerequisites needed to begin operation
  - At least a Pentium-class 32-bit CPU clocked >= 100Mhz
    - 80486 processor is unable to perform the required DSP
  - DSL speed Internet connection for best results
    - Dial-up should work, if you don't mind lag and phase jitter
      - » PGPfone/iParty WAV file upload over PSTN long before VoIP
  - Java SE (Standard Edition) JRE (Runtime Environment)
    - Download from http://java.oracle.com or http://java.sun.com
  - Web browser with JavaScript support
    - i.e. Internet Explorer 10, FireFox 11, Opera 11, Chrome Beta
    - May need to add WebSDR domain to Trusted Sites due to applets

# A WebSDR tuned into USB on 20 meter




**Frequency:** 14218.01 kHz

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Or tune by clicking/dragging on the frequency scale.

**Bandwidth:**

**2.99** kHz @ -6dB; **3.45** kHz @ -60dB.

wider | CW-wide | LSB | USB | AM

narrower | CW-narrow | LSB-nrw | USB-nrw | AM-nrw

Or drag the passband edges on the frequency scale.

**Waterfall settings:**

| Speed: | Size: | View: |
|---|---|---|
| (•) slow | ( ) small | ( ) spectrum |
| ( ) medium | (•) medium | (•) waterfall |
| | | ( ) weak sigs |
| ( ) fast | ( ) large | ( ) strong sigs |


-72.5 dBm; peak -62.0 dBm;

mute

**Logbook:**

Call of station that you hear: OZ8CTH

Comments, if any: Peter from Denmark submit

Note: time, frequency, your name/call, and DXCC information are added automatically.
To view the logbook, click here (ctrl-click for new tab/window).

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This WebSDR is currently being used by 6 user(s) simultaneously:

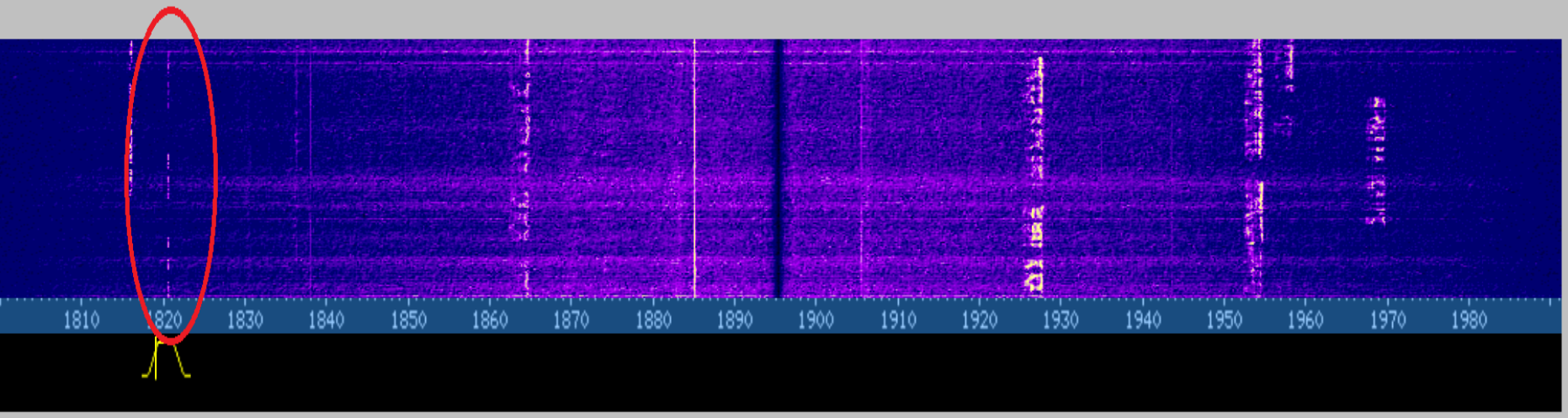
::ffff:81.217.17.86

::ffff:78.42.221.28

# Waterfall Observation of CW Transmission

View:

○ all bands ○ others slow ◉ one band ○ blind




**Frequency:** 1819.19 kHz

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Band: ◉ 160m ○ 80m ○ 40m ○ 20m ○ 30m

Or tune by clicking/dragging on the frequency scale.

**Bandwidth:**

**1.79** kHz @ -6dB; **2.25** kHz @ -60dB.

wider | CW-wide | LSB | USB | AM

narrower | CW-narrow | LSB-nrw | USB-nrw | AM-nrw

Or drag the passband edges on the frequency scale.

**Waterfall settings:**

| Speed: | Size: | View: |
|---|---|---|
| ○ slow | ○ small | ○ spectrum |
| ◉ medium | ◉ medium | ○ waterfall |
| ○ fast | ○ large | ○ weak sigs |
| | | ◉ strong sigs |

zoom out | zoom in

Or zoom with scroll wheel on waterfall.

# Some Reliable WebSDR Service Hosts

- http://w4ax.com
  - Georgia, United States
- http://www.websdr.at
  - Markt Allhau, South East Austria
- http://websdr.pa3weg.nl
  - The Netherlands

# FLEX Systems PowerSDR Desktop App

- Open Source software written in Microsoft Visual Studio with C and C#
  - Runs as a separate desktop program as opposed to an HTML page with Java applets like WebSDR
- Connects to FLEX-(N)000 transceiver units
  - Designed from the ground up to operate in combination with the PowerSDR software
    - Lacks “old school” external analog push-button controls
- Control panel dials much more fine-grained in comparison to what WebSDR’s have to offer

# FLEX Systems PowerSDR Desktop App (cont'd)

- Renders waterfall visualization through DirectX with a Fast-Fourier-Transform algorithm parallelized by a Windows port of the POSIX threads library (libpthreads)
  - Other graphical eye candy created with classes from the .NET Framework's *System.Drawing* namespace and Windows Forms designed visually (point 'n' click.)
- Interoperable with MixW due to ActiveX messaging API
- MixW supports older DDE (Dynamic Data Exchange) too
- Is it possible to feedback the output of a WebSDR on one PC into the input of another PC running PowerSDR? (best of both worlds)

# FLEX-5000A Physical I/O Ports

# AX.25 Bulletin Board Systems

- Yes, BBSes are definitely still around. They're just not on 9600 baud landline modems as they were before the Internet blossomed.
- Anyone that remembers dialup X.25 gateways operated by Sprint telecommunications and other similar entities in decades past already knows about the AX.25 protocol.

- AX.25 is also used by APRS
  - Automatic Position Reporting System
  - However, APRS operates in an datagram mode
    - More efficient for beacon-style broadcast operation
  - AMPR BBSen utilize the virtual-circuit connection mode

- AX.25 "digipeaters" allow what would otherwise be individual packet nodes to mesh in groups of nearby peers
- Most AX.25 or "packet radio" BBS stations allow incoming Telnet
  - Some even provide access to a client for outgoing Telnet, thus exposing a proxy for arbitrary TCP connection establishment.
    - *A screenshot demonstrating this point will be shown in the next slide!*

# Hopping Between AX.25 Nodes

```
top of the Blue Mountains near Tollgate, Oregon.

For more assistance, contact wa7v@wa7v.com or see http://wa7v.com/


Area:           Current msg# 0 of 0.
?,A,B,C,CALL,CONF,F,FLEX,J,K,L,N,NR,P,PNW,R,S,T,TUTOR,V,WX,X,XNET>
telnet ve3zda.ampr.org
Trying...  The escape character is: CTRL-T
*** connected to 44.135.90.2:telnet

JNOS (ve3zda.ampr.org)

(Please use callsign to LOGIN & first name for PASSWORD)
login:
Password:

[JNOS-2.0h-BFHIM$]


'?' or 'h command` for help. Please send local messages to 'users'.
```

# Amateur Radio Class A Subnet

```
NetRange:       44.0.0.0 - 44.255.255.255
CIDR:           44.0.0.0/8
OriginAS:
NetName:        AMPRNET
NetHandle:      NET-44-0-0-0-1
Parent:
NetType:        Direct Assignment
RegDate:        1992-07-01
Updated:        2009-06-19
Ref:            http://whois.arin.net/rest/net/NET-44-0-0-0-1

OrgName:        Amateur Radio Digital Communications
OrgId:          ARDC
City:
StateProv:
PostalCode:
Country:        US
RegDate:
Updated:        2011-09-24
Ref:            http://whois.arin.net/rest/org/ARDC
```

# Most Popular AX.25 BBS Software

- JNOS 2.0 available at http://jnos.org
- TNOS 3.00 (Tampa Network Operating System)
  - Based on code by KA9Q from an earlier MS-DOS implementation of AX.25 *and* BBS functions; full story at http://tnos.sf.net
- Features include: mail, chat, announcements, CQ, real-time QSL logs from anyone on a node in the cluster area, ANSI colored console text, station configuration/statistics & more
- Both run on the Linux operating system
  - Nowadays, it would be extending an already large project by running a packet radio BBS on anything other than Linux.
  - However, it's quite simple to get yourself connected to an AX.25 bulletin board with just about any operating system (and a call sign, of course.)

# AX.25 Cluster QSL Announcements

```
DX de EA2DGP:      7110.0  EC5BYB       Comandancia G.C. I. Baleares   1836Z EA
DX de 4S7BRG:      7037.2  EW8CM        tnx QSO                     EU 1835Z 4S
DX de N4ANZ:      21278.0  V25AA        57 in tennessee             V2 1836Z
DX de CT5KDN:     28480.0  PY1NS        Band open but no takers    +PY 1836Z CT
DX de EA4GB:      14255.0  6V7S         UP 5 Vladimir Senegal       6W 1837Z EA
DX de WO6M-7:     28019.8  V44KAI                                  +V4 1837Z CA
DX de EA1AHY:     21071.0  HI7MC        BPSK31 via [L] Miguel La Roman 1838Z EA
DX de EB6AAO:      7120.0  EA1BPC       Comandancia G.C de Oviedo   EA 1837Z EA6
DX de K7GSE:      18085.0  HC2/W7SE                                 HC 1837Z WA
DX de VE3AXW:     14205.0  ZS1AFS       why have u not uploaded ur log 1838Z ON
DX de DF1PU:      14012.0  PJ4/W4IX     dupl up1 599                PJ4 1837Z DL
DX de W4IMD:      28490.0  KP4LIV       FK68-EM84                  +KP4 1838Z GA
DX de K3FBI:      14273.0  KP4LIV       FBI Club Station           +KP4 1837Z VA
DX de DE1BKT:    144300.0  DL0GM        SWL Rep. 57 JO30NT          DL 1838Z DL
DX de KA2VHY-7:   18087.0  K3VEI        not a real call              K 1838Z NJ
DX de F4EIT:      21224.0  PT2AC        57 tnx GLAUB               +PY 1838Z F
DX de YV5JGO:     18085.0  HC2/W7SE     599 tnx splx 73s            HC 1838Z YV
DX de EA2DWG:      7072.0  EA2ABI       D.G.D.GASTEIZ              +EA 1838Z EA
DX de OH7HXH:    144053.0  RA1DM        cq                          UA 1839Z OH
DX de DF9CY:      50096.0  SM5EDX       JO54AL<AUR>JO89FP still 57a CQ 1839Z DL
DX de AK5X:       28039.8  PJ2/N0VD     599 NTX                    +PJ2 1839Z TX
DX de W3LPL-3:    24896.0  6Y2T                                     6Y 1839Z MD
DX de PY1ZV:      28480.0  PY1NS        cq cq dx                   +PY 1840Z PY
:
```

# Reliable Packet Radio BBSes

- ***telnet://dxc.kr9u.net***
- ***telnet://wa7v.ampr.org***
- ***telnet://ve3zda.ampr.org***

- The default telnet port is *tcp/23*, but the outdated bulletin board directories on the web often contain listings with non-standard port numbers, e.g. it must be specified in the URL like so:
  - *telnet://bbs.host.dom:7374*

- If your Windows installation doesn't include a telnet client, then download a copy of GNU **netcat.exe** or BSD **nc.exe**. They work just as well.

- Note: Telnet DX'ing is at the mercy of Internet firewalls within the route to the target BBS
  - Can't connect directly? Try using another BBS as a proxy..

# Ham Radio on a PC with no Mouse

- `multimon` command-line program for Linux
- Written in C and easily compiled with the `make` command
  - Standard code needs no `./configure` script
- Open sourced with the GPL license
- Actively developed for at least a decade
  - Mature code base, latest release: 06 Feb 2012
- Supports DTMF,POCSAG,AX.25 (A)FSK & HAPN
- If you really want to use a mouse then perhaps look into the `microsat` low-earth orbit satellite tracking program for X11

# Ham Radio on a PC with no Mouse (cont'd)

- `multimon` is coded by Thomas Sailer HB9JNX/AE4WA
  - Released an alpha version of his RTTY, Amtor (Sitor), and Pactor 1 decoder: hf-0.1.tar.gz
  - Web site features early demo version of an HF fax program (TIFF-standard facsimile)
  - Also wrote a corresponding Linux device driver that does: sound-card-to-packet-radio-modem
  - Released PC/FlexNet for Windows 95 before coding on Linux.
  - Travels to speak at ARRL and TAPR conferences
  - Published whitepaper about D-ATV with MPEG2 on DVB-S
    - Satellite Digital Video Broadcasting via QPSK
  - Apparently really serious about DSP and high-speed wireless..

# Why Linux Has Good AX.25 Support

- Alan Cox (GW4PTS)--a British lad with strong convictions regarding open source software and a long-time Linux kernel contributor.
  - Pioneered the coding of AX.25 Linux device drivers during the mid-90's in kernel version 1.2.13.
    - Stable version in Feb 2012 is now 3.2.6 with release candidates available in the 3.3 mainline
  - GW4PTS also helped program the Linux TCP stack
    - TCP/IP tunneling over AX.25
    - Internet protocol packets were already on the air years before IEEE 802.11b and Wi-Fi came along

# Why Linux Has Good AX.25 Support (cont'd)

- It's the only major operating system available with ***standard***, ***native*** and ***free*** AX.25 included
  - No nonsense from a variety of patchwork style code and half-broken API's from third-party vendors
    - Stark contrast to Microsoft Windows packet radio software that requires at least half a dozen drivers/libraries (.INF/.SYS/.DLL/etc.)
- Once Alan (GW4PTS) made his initial submit, many others followed up with their own driver code, which is why now we have this:

# Linux Packet Radio Support Options

--- Amateur Radio support
*** Packet Radio protocols ***
< > Amateur Radio AX.25 Level 2 protocol
[ ] AX.25 DAMA Slave support (NEW)
< > Amateur Radio NET/ROM protocol
< > Amateur Radio X.25 PLP (Rose)
AX.25 network device drivers --->

< > Serial port KISS driver (NEW)
< > Serial port 6PACK driver (NEW)
< > BPQ Ethernet driver (NEW)
< > Z8530 SCC driver
[ ] additional delay for PA0HZP OptoSCC compatible boards
[ ] support for TRX that feedback the tx signal to rx
< > BAYCOM ser12 fullduplex driver for AX.25 (NEW)
< > BAYCOM ser12 halfduplex driver for AX.25 (NEW)
< > BAYCOM picpar and par96 driver for AX.25
< > BAYCOM epp driver for AX.25
< > YAM driver for AX.25 (NEW)

# TAPR AX.25 Layer 2 Special Interest Group

- Currently, the problem that needs to be solved is the so-called “Tower of Babel” (various protocol stacks) that grew unrestricted onto the first AX.25: ROSE,Net/ROM,TexNet,KISS,etc.
- The lack of compatibility slows transport speeds when frequencies get busy because there’s no agreed upon **C**ollision **D**etection/**A**voidance
  - Detect if one station continuously keys over another
- Ethernet’s link layer already has this (CSMA/**CD**/**CA**)
  - Carrier Sense Multiple Access
- Concept outlined on the ax25.net web site
- Tucson Amateur Packet Radio to the rescue

# What's In Store for the Future

- Even more "realistic" "virtual" amateur radio
  - Multiple transceivers running on the same machine simultaneously with built-in CPU support for virtualization suites such as VMWare Fusion and Oracle VirtualBox
- Tablet computers likely to be running:
  - Microsoft Windows 8 with touch-screen Metro UI
  - Apple iPads running iOS
  - No mouse *or* keyboard necessary!
  - Apple Safari browser *should* handle WebSDR
  - Uses WebKit SDK (Software Development Kit)
    - Same JavaScript engine as Chrome, but untested..

# What's In Store for the Future (cont'd)

- Likely to see the most amateur radio software for Windows 8 due to extra language support
  - iOS apps are almost always coded in C or Objective C
  - Metro apps can be C++, C#, HTML5 and/or JavaScript
    - The .NET Framework advantage of language agnosticism
      - Perhaps support for Ruby, Python, F# and others isn't too far off..
  - Android is out of the question as Java's mobile edition isn't meant for low-level hardware coding
    - Perhaps WebSDR will work, but forget about PowerSDR.
    - There's always the out-of-band management approach
      - e.g. Remote station control with DTMF over CDMA

# Related WWW Hyperlinks

- http://www.websdr.org
- http://www.gnuradio.org
- http://www.opendigitalradio.org
- http://tnos.sf.net
- http://www.langelaar.net/projects/jnos2/
- http://www.flex-radio.com
  - Manufacturer of FLEX-5000A appliance
- http://www.baycom.org/~tom/ham/linux/multimon.html
  - Linux command line digital UHF transmission decoder
- http://www.openmokast.org
  - Linux Digital Video Broadcast on VHF, then receive video stream out-of-band in corresponding smartphone app
- http://decal.sdf.org
  - My personal web site has a humble amateur radio section where these presentation slides will be uploaded

# QSL's, 73's

- ***Questions?***
  - There were a lot of acronyms.
  - Did you take notes? ;-)
- ***Comments?***
  - Did I accidentally exceed a legal boundary?
    - My license is currently Technician class.
  - Any obvious typos or technical errors?