Solving Problems using IPv4

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Solving Problems with IPv4

- This talk is an overview of things you can do with IPv4
- There is an entire RMHAM University that is a deep dive on every topic we will touch on today
  - https://www.rmham.org/course-syllabus/
- IPv4 is a robust and redundant universal transport mechanism
  - Extensible using new protocols
  - Automatic recovery from failures is inherently supported

What is Internet Protocol version 4? (IPv4)

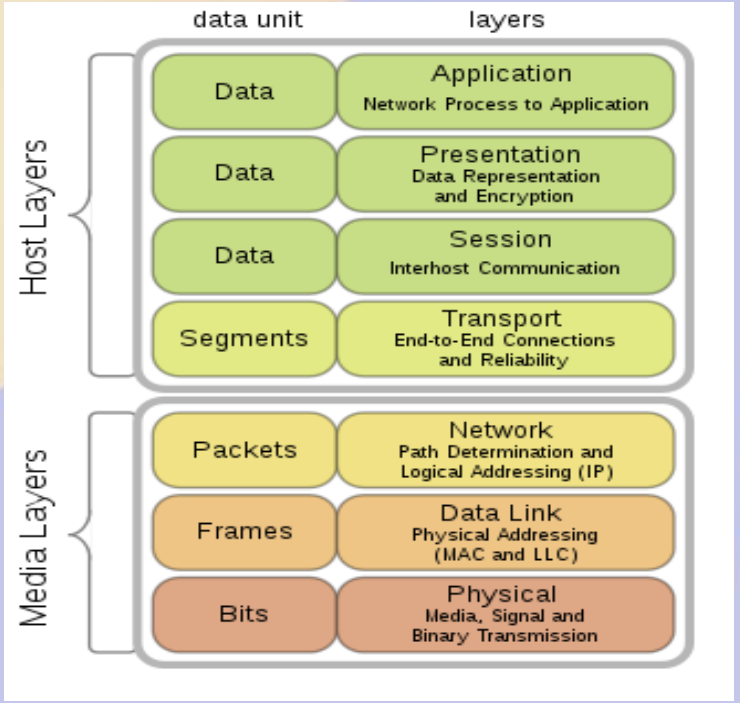
- Packet switched network
  - Introduced in 1981
  - Replaced older circuit switched networks
- Advantages
  - Decentralized, hierarchical configuration
  - Robust, dynamic routing
  - Supports 4,294,967,296 unique addresses
- Network of networks (subnets)

Basic IP Protocols

- Internet Control Message Protocol (ICMP)
  - Used for control and debugging
- Transmission Control Protocol (TCP)
  - Reliable virtual circuit
  - Built-in congestion control and error correction
- User Datagram Protocol (UDP)
  - Best effort datagrams
  - Well matched to VoIP

OSI Network Model

- Conceptual representation of network protocols
  - HTTP - Application
  - TCP - Transport
  - IP - Network
  - Ethernet – Data Link
  - IEEE 802.3u – Physical
- Upper layers hide complexity of lower layers



Protocols Built on IP

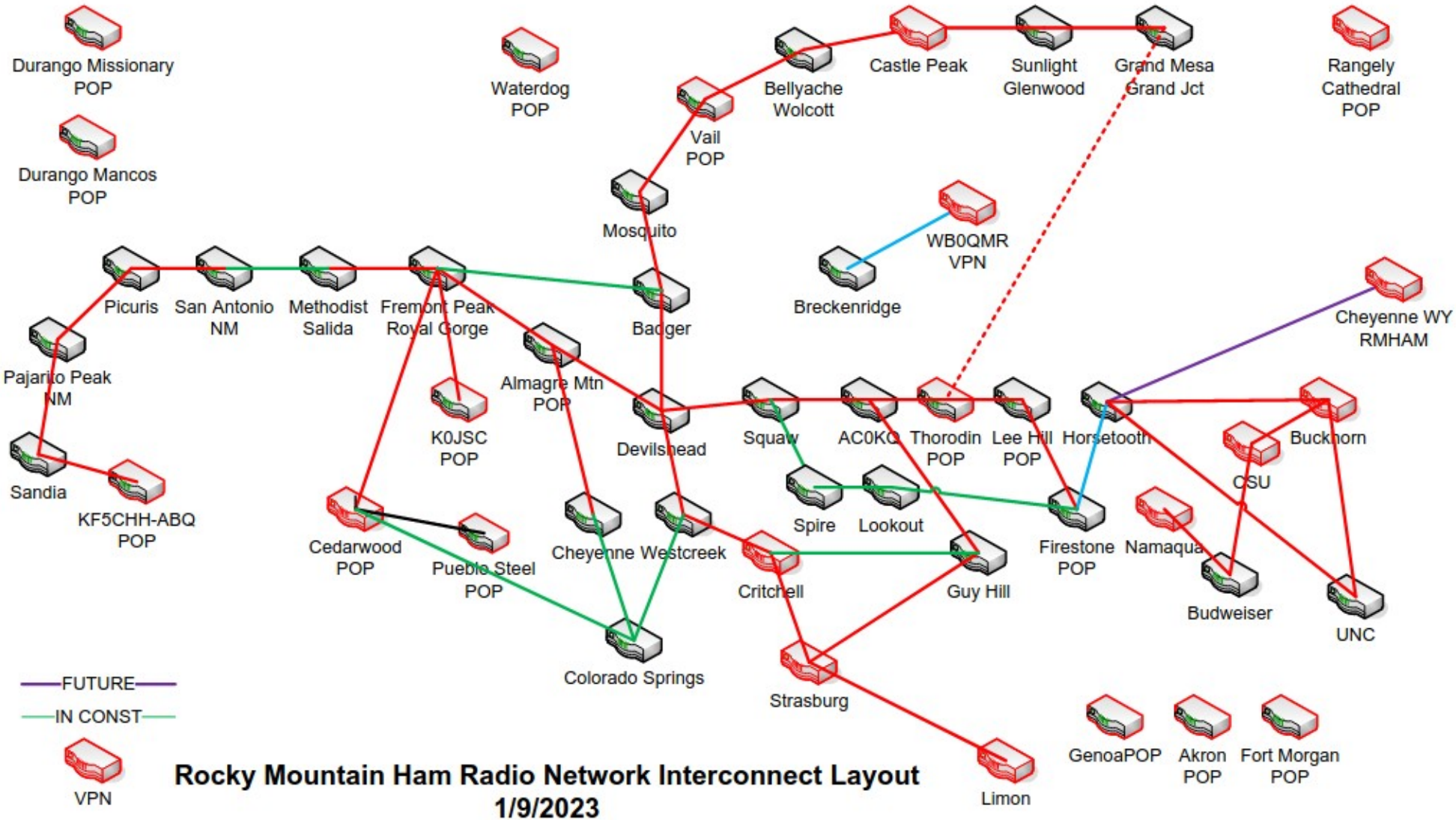
- DNS (UDP) - name resolution
- NTP (UDP) - time synchronization
- HTTP/HTTPS (TCP) - web browsing
- SMTP (TCP) - email
- telnet (TCP) - remote logins
- ssh (TCP) - secure remote logins
- SNMP (UDP & TCP) - hardware management
- VoIP (UDP) - audio
- RTSP (UDP) - video

Protocols built on ssh

- scp - secure remote file copy
- rsync - clever secure remote file copy
- sftp - secure file transfer protocol (ftp)
- X11 scp tunnel
- tunnel - packet transport over tcp
  - local or remote bi-directional port forwarding

Routing Protocols

- Open Shortest Path First (OSPF)
  - Used on RMHAM network
  - Find shortest path to destination
    - Sum of path "length" weights
  - Fast and reliable
  - Link state routing
- Border Gateway Protocol (BGP)
  - Runs the internet
  - Slower and require more configuration
  - Path-vector routing



Rocky Mountain Ham Radio Network Interconnect Layout
1/9/2023

Virtual Private Networks (VPN)

- Creates a point to point tunnel
  - System level virtual circuit
  - Complexity of intermediate networks are hidden
  - Robust and redundant transport
- Types of VPN
  - Secure Socket Tunneling Protocol (SSTP)
    - Built on SSL/TLS to port 443 (looks like HTTPS)
  - OpenVPN (OVPN)
  - WireGuard
  - ZeroTier

Mikrotik Hardware

- RouterOS is designed for routing
  - Custom Linux kernel
  - Supports IPv4, OSPF, BGP, …
  - Any port can perform any function
  - Same interface regardless of model
  - Command line and well designed GUI
- Reasonable cost
  - Very reliable (but lightning...)
  - Targets Wireless ISP market
    - Long range radios (2GHz, 5GHz, 60GHz)
    - International versions can operate in Ham Band


RB2011UiAS-RM
routerboard


CLOUD CORE

IP Enabled Hardware

- Network and network monitoring equipment
- Site computers
- Repeaters (DMR,AllStarLink, PiStar, MMDVM,...)
- Remotely Base/Software Defined Radio
- Solar controllers
- Uninterruptible Power Supplies
- AC and DC Power Distribution Systems
- VoIP phones and IP cameras
- Alarm, access & environmental systems

Other uses of IP

- Cell phones
- Radio programming
- NASA Deep Space Network (with special mods)
- Internet of Things (IoT)
  - Internet connected refrigerators, faucets, toilets, ...

IP Basics

- Each device has a unique IP address
- Each service/process has a unique port
- Devices are connected to a local subnet
  - Ethernet/Wifi uses a MAC-IP address mapping
- Subnets are connected by routers
  - A router decides where to send non-local packets
  - Subnets between routers are called links
  - The address (device) to send non-local packets to called a gateway

What is a subnet?

- Part of a greater (interconnected) network
- Group of IP addresses that can directly communicate (e.g. via ethernet or WiFi)
- Sometimes called Local Area Network (LAN)
- Devices on a subnet
  - Have the same leading bits (subnet address)
  - Can directly talk to other devices on the subnet
- Hardware that facilitate device to device communications on a subnet is a hub or switch

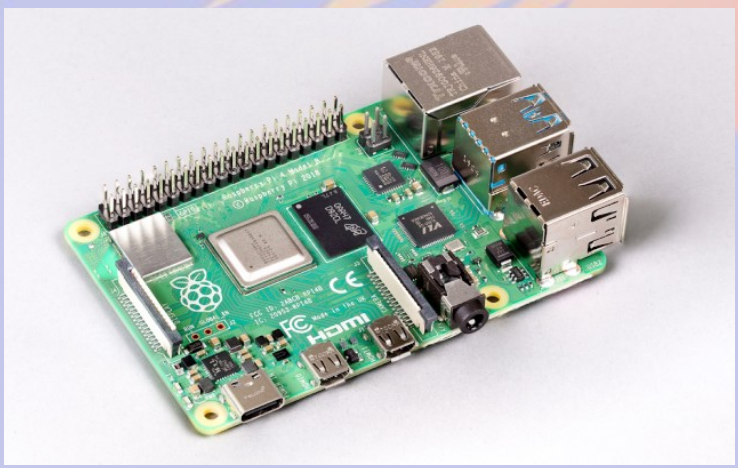
Network Address Translation (NAT)

- Also called masquerade
  - Uses port numbers to share an (external) IP
  - Router pretends to be devices behind it
- Router rewrites packets both ways
- Extended the life of IPv4 by decades
- Limited security measure
  - Only the router can be reached from internet
  - Port forwarding allows inbound connections

Networked Devices

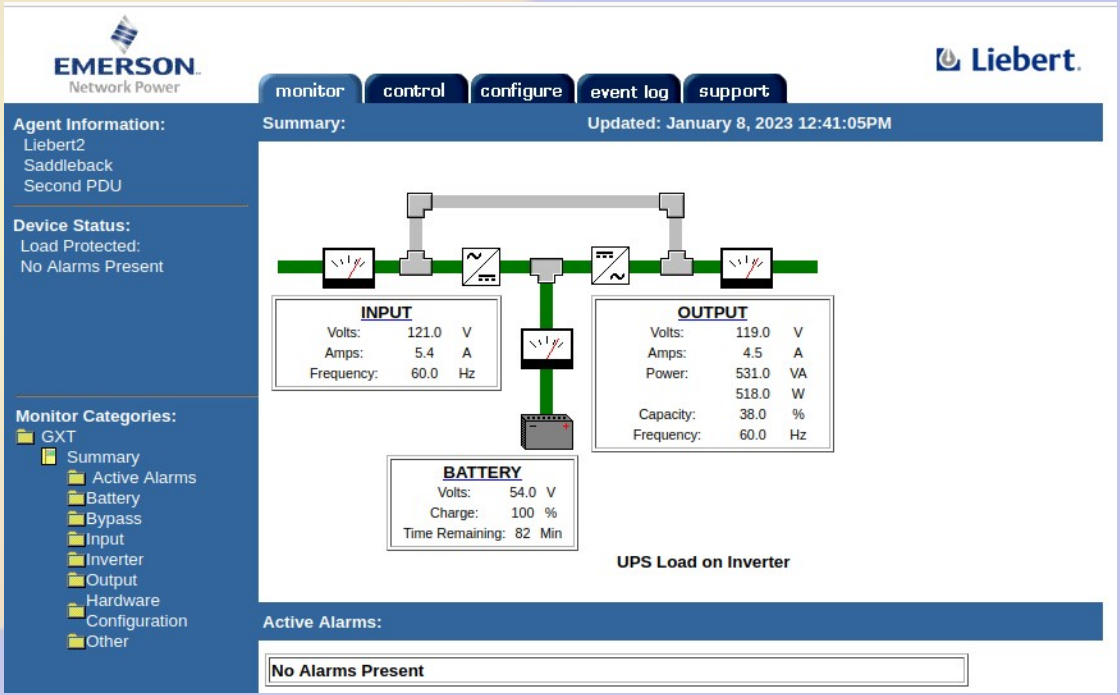
Site Computer

- Industrial computers are robust
- Preferably DC powered
  - SSD for temperature tolerance
- Raspberry Pi can work
  - Use a metal case, good power and high quality SD card
- Shielding is important, both for the computer and any cables
- Site computers add many new capabilities to control and monitor



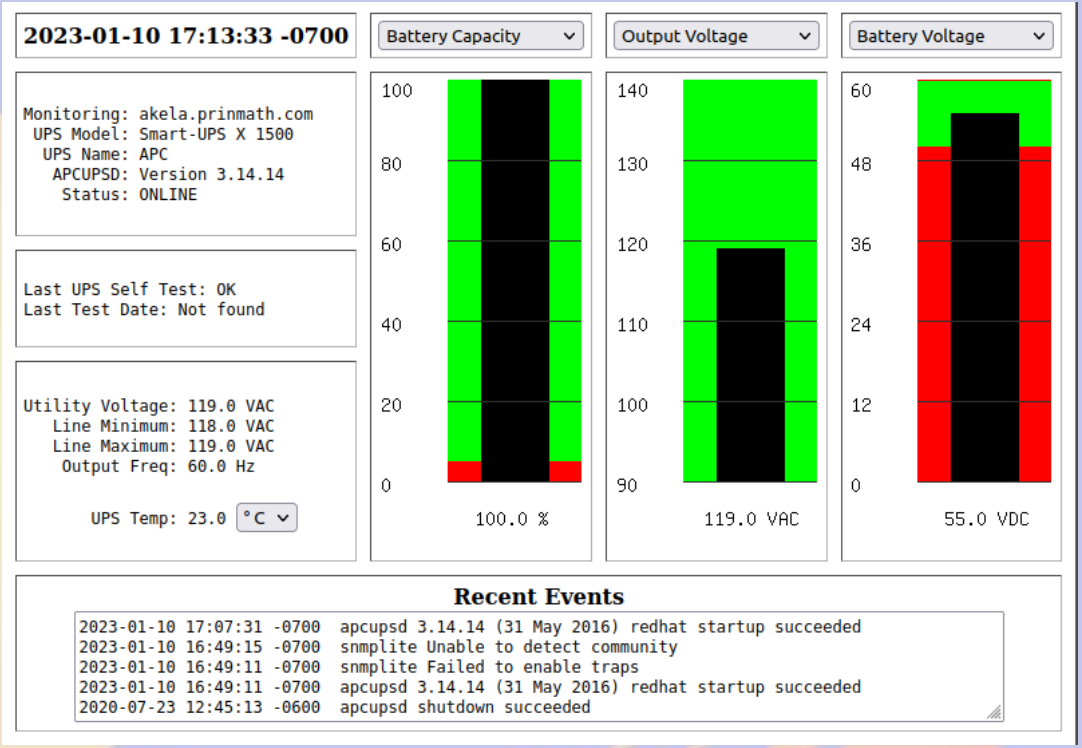
Uninterruptible Power Supplies

- Higher end devices often are IP enabled
- Web and telnet access via Network Module
  - Also serial or USB



apcupsd

- Power monitor for any APC UPS (IP or USB)
- Linux deamon and web servers



APCUPSD UPS Network Monitor

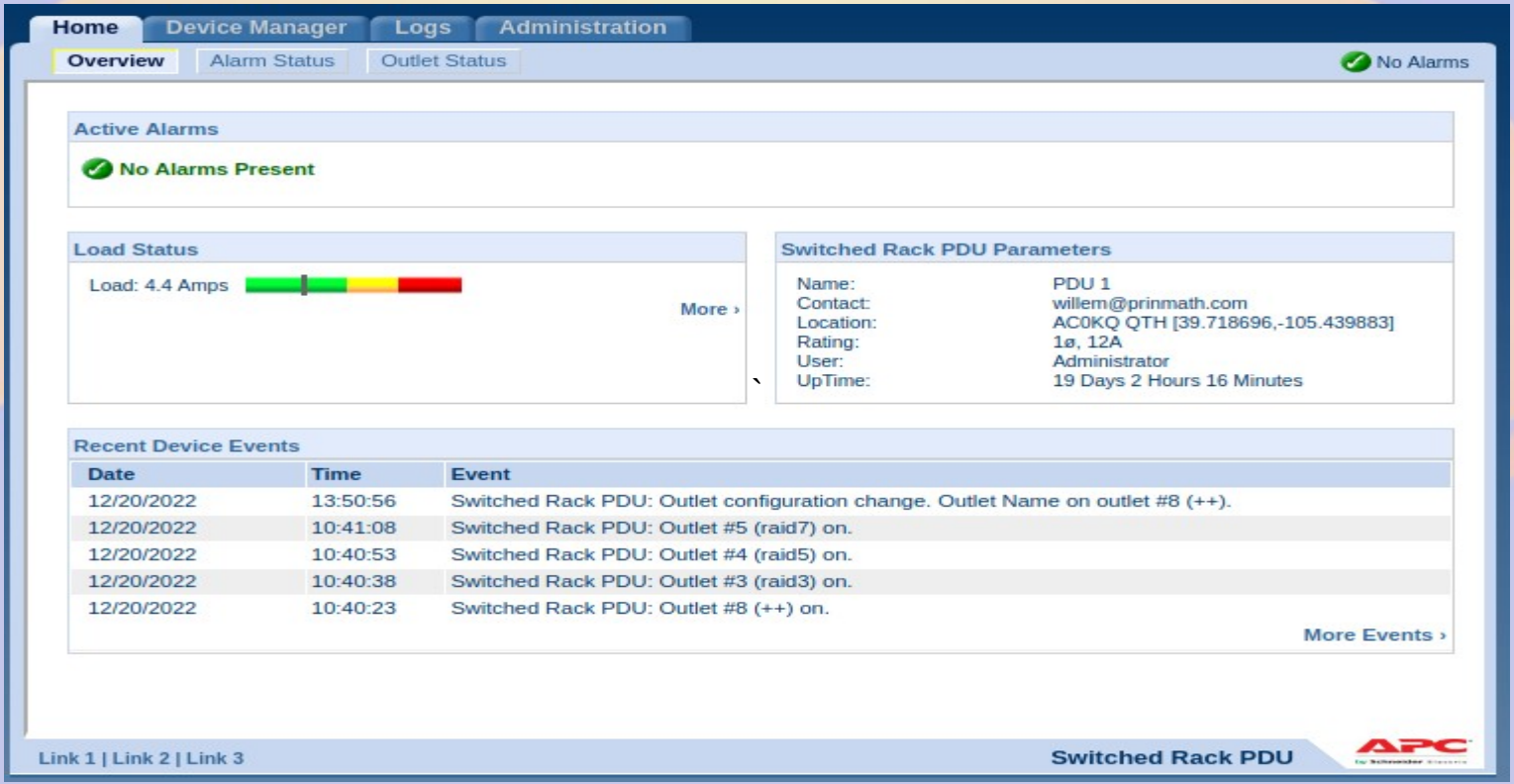
Tue Jan 10 17:09:52 MST 2023

System	Model	Status	Battery Chg	Utility	UPS Load	UPS Temp	Batt. Run Time	Data
apc01	Back-UPS ES 350	ONLINE	100.0 %	120.0 VAC	3.0 %	-	71.9 min.	All data
apc02	Smart-UPS X 1500	ONLINE	100.0 %	119.0 VAC	4.0 %	23.0° C	151.0 min.	All data
apc04	Back-UPS ES 350	ONLINE	100.0 %	121.0 VAC	3.0 %	-	71.9 min.	All data
apc12	Back-UPS NS 575G		12.0 %	121.0 VAC	0.0 %	-	52.8 min.	All data

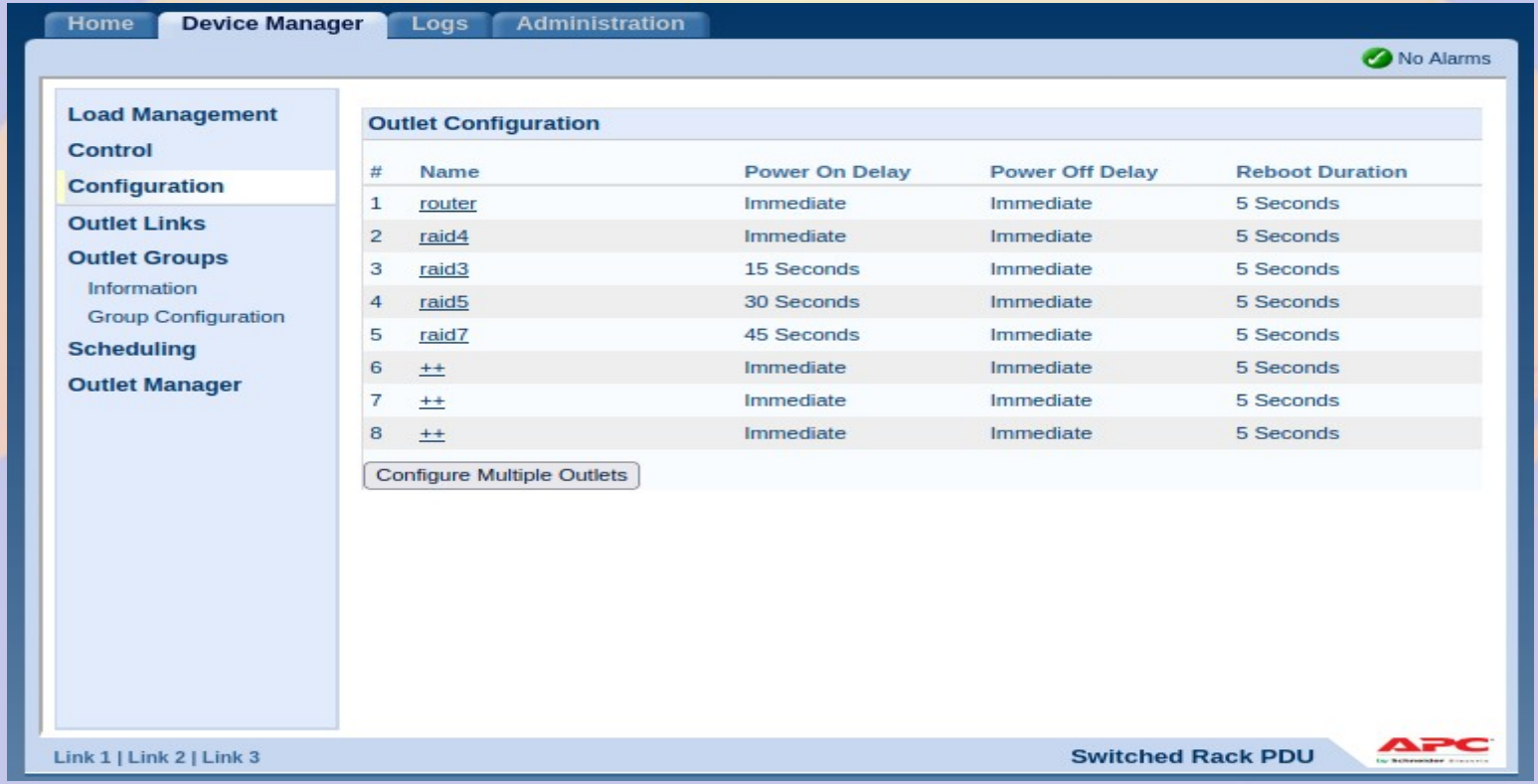
AC Power Distribution

- AP7900 - eight controllable outlets
  - Supports cascading power on and pulse off
  - Web, ssh and SNMP via IP

Power Distribution Unit 1

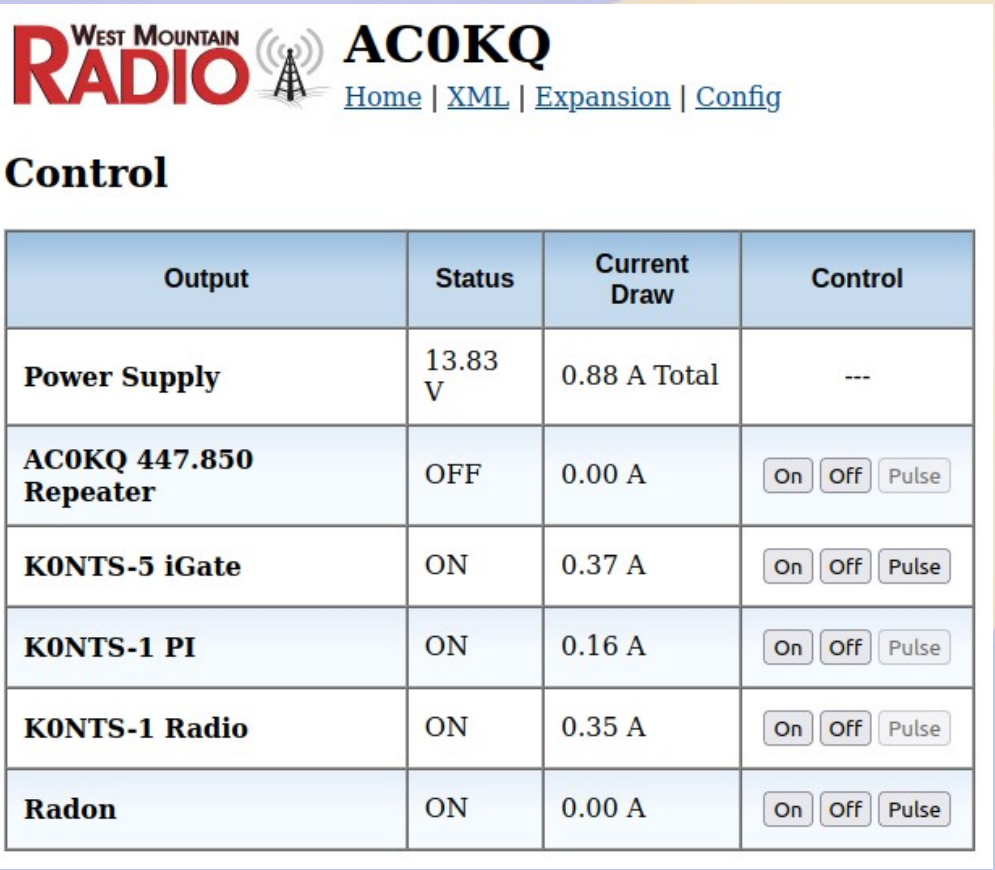


Power Distribution Unit 2



RigRunner 4005i

- 12V DC or 24V DC
- 40A total capacity
- Soft fuse setings
- Low voltage disconnect
- Email alerts
- Broken SNMP



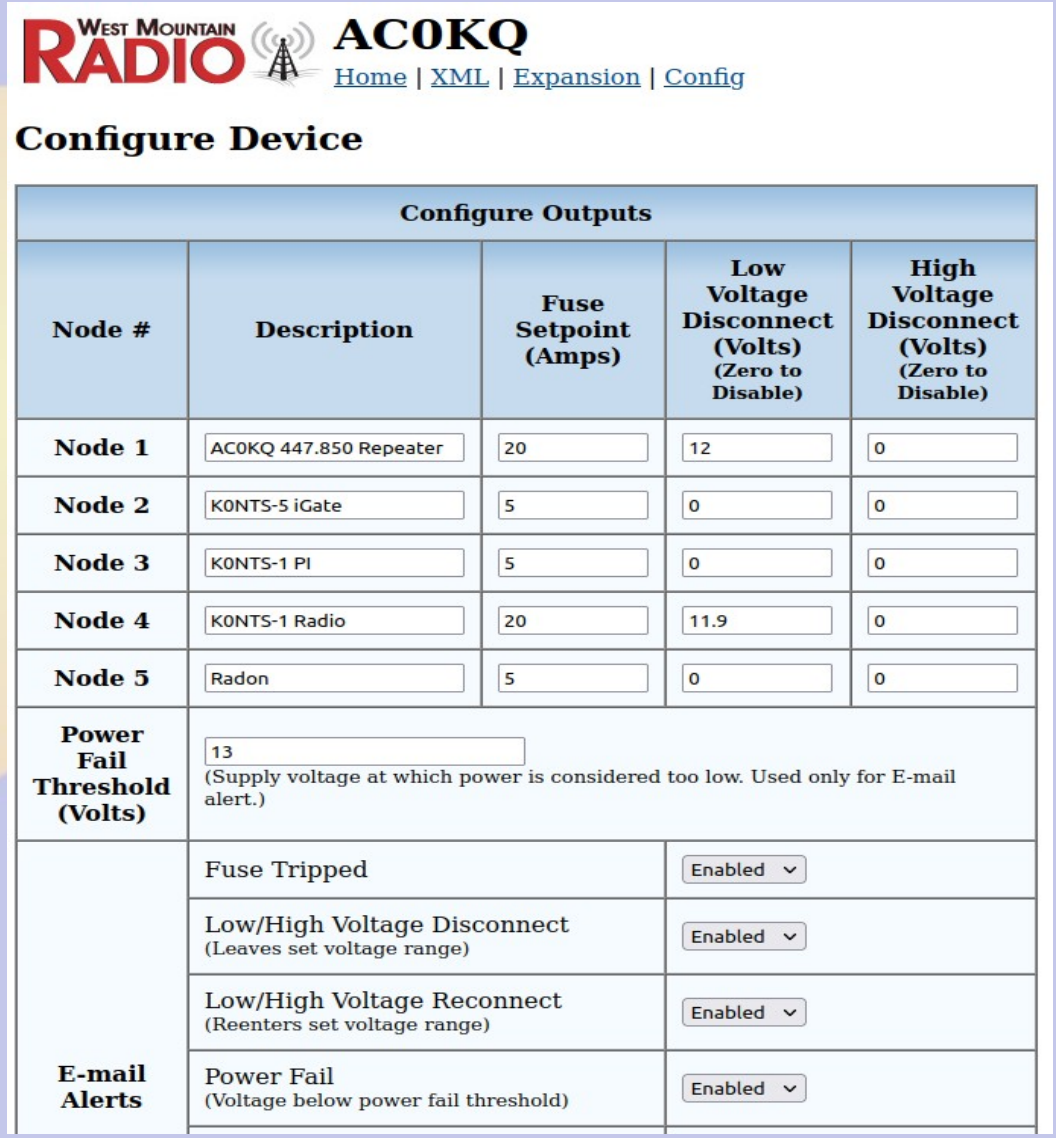
West Mountain RADIO

AC0KQ

Home | XML | Expansion | Config

Control

Output	Status	Current Draw	Control
Power Supply	13.83 V	0.88 A Total	---
AC0KQ 447.850 Repeater	OFF	0.00 A	On Off Pulse
K0NTS-5 iGate	ON	0.37 A	On Off Pulse
K0NTS-1 PI	ON	0.16 A	On Off Pulse
K0NTS-1 Radio	ON	0.35 A	On Off Pulse
Radon	ON	0.00 A	On Off Pulse



West Mountain RADIO

AC0KQ

Home | XML | Expansion | Config

Configure Device

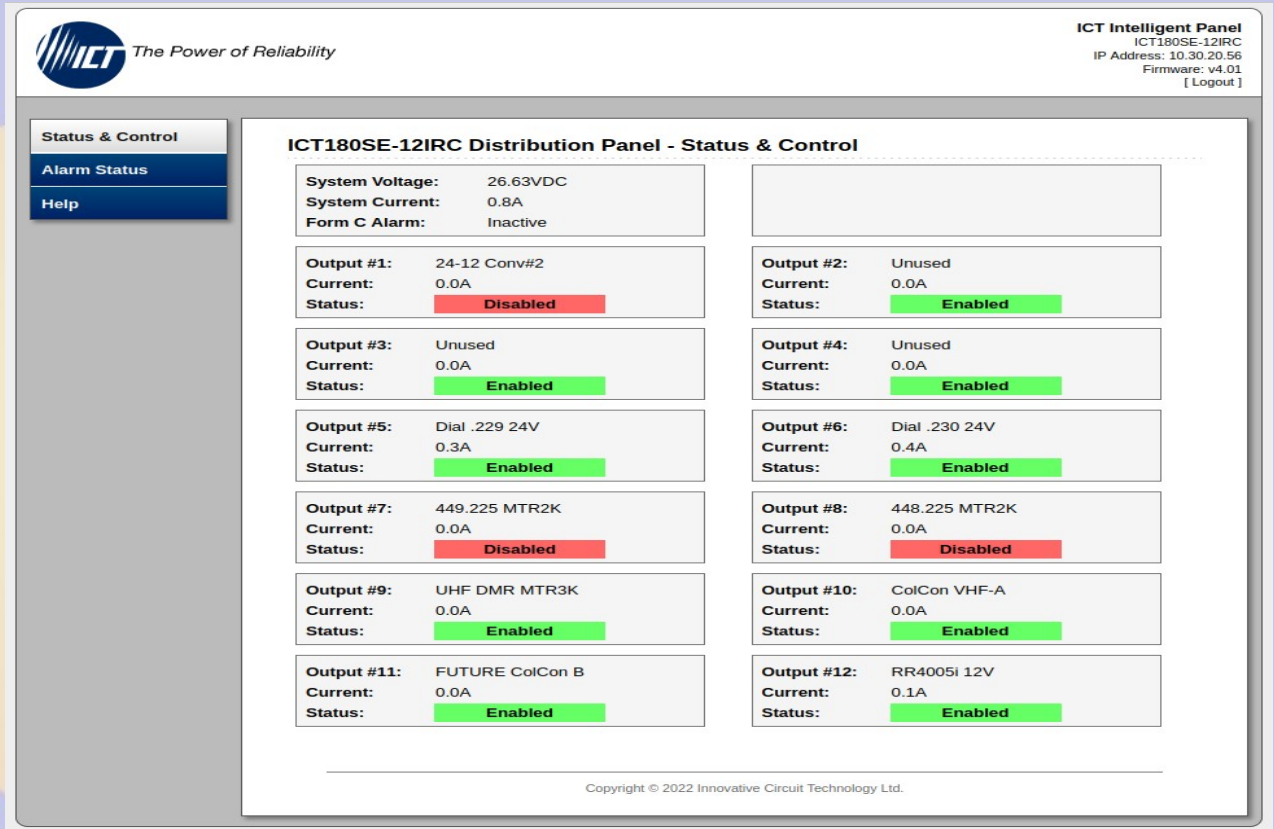
Configure Outputs

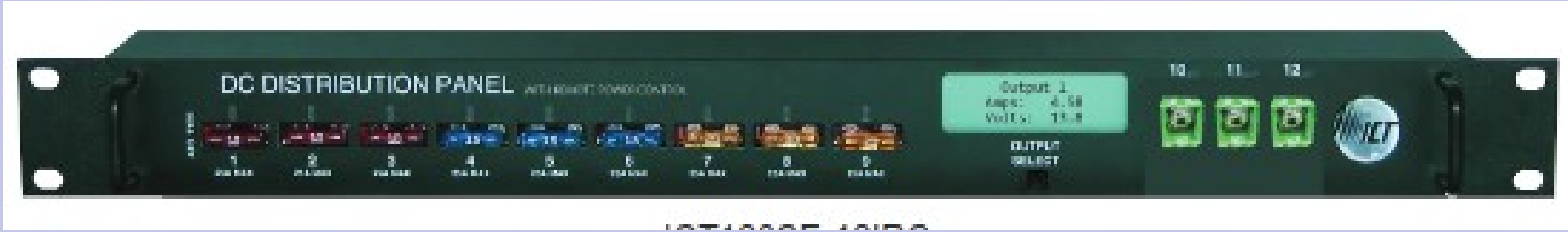
Node #	Description	Fuse Setpoint (Amps)	Low Voltage Disconnect (Volts) (Zero to Disable)	High Voltage Disconnect (Volts) (Zero to Disable)
Node 1	AC0KQ 447.850 Repeater	20	12	0
Node 2	K0NTS-5 iGate	5	0	0
Node 3	K0NTS-1 PI	5	0	0
Node 4	K0NTS-1 Radio	20	11.9	0
Node 5	Radon	5	0	0

Power Fail Threshold (Volts): 13
(Supply voltage at which power is considered too low. Used only for E-mail alert.)

E-mail Alerts	Fuse Tripped	Enabled
	Low/High Voltage Disconnect (Leaves set voltage range)	Enabled
	Low/High Voltage Reconnect (Reenters set voltage range)	Enabled
	Power Fail (Voltage below power fail threshold)	Enabled

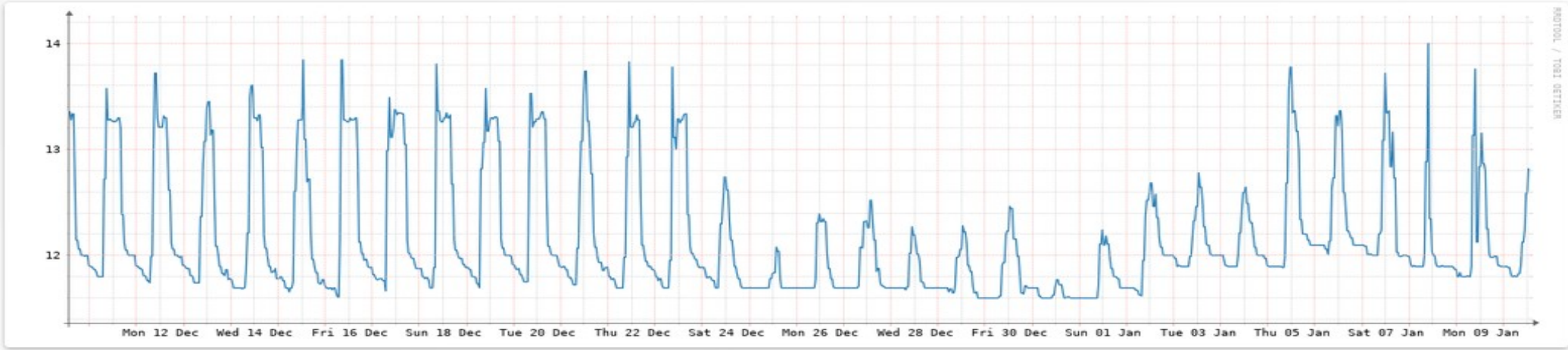
ICT180SE-12IRC High Current DC Power Control (150A 12/24V)

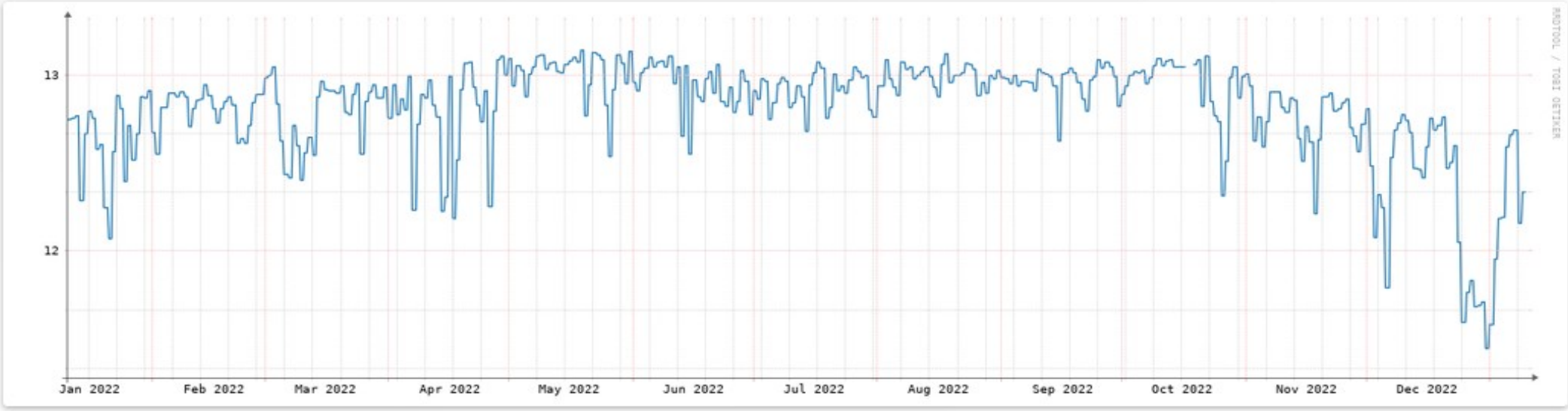




Solar Controller

Mosquito Peak Battery Voltage





Monitor Systems

- One wire sensors
  - DS18x20 temperature
  - DS2438 humidity
- Web server & POST

			Channel 1	Channel 2	Channel 3
Devices Connected:	6				
Loop Time:	5.855 Sec	**Devices:**	2	4	0
Poll Count:	987099	**Errors:**	0	5	0
Supply Voltage:	5.12	**Voltage:**	4.87	4.85	4.87

Description	ROM ID	Device	Channel	Health*	Value
Parasite power thermometer	720008002F51BD10	DS18S20	1	7	62.6 °F
Parasite power thermometer	990008002F476710	DS18S20	1	7	58.1 °F
Parasite power thermometer	890008002F512010	DS18S20	2	7	79.7 °F
Parasite power thermometer	6A0008002F41E010	DS18S20	2	7	26.6 °F
Parasite power thermometer	630008020F969810	DS18S20	2	7	180.5 °F
Parasite power thermometer	190008002F4D3910	DS18S20	2	7	58.1 °F

*Health ranges from 0 to 7, 0 is disconnected, 7 is healthy

VoIP (SIP) Phone

- Requires an Asterisk PBX
- Many use 48V power
  - Some operate on 5V
- Very useful when cell coverage is marginal

IP Cameras

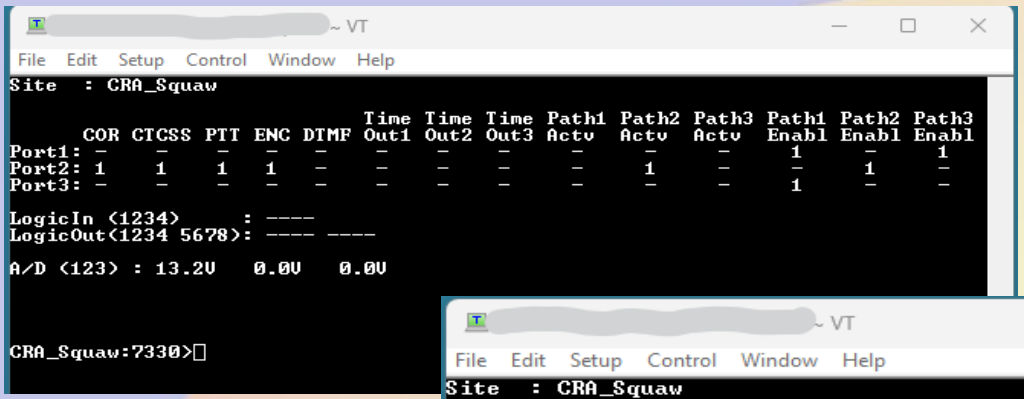
- IR for dark conditions
- Pan-Tilt-Zoom
- Blue Iris DVR software
  - Good at motion detection

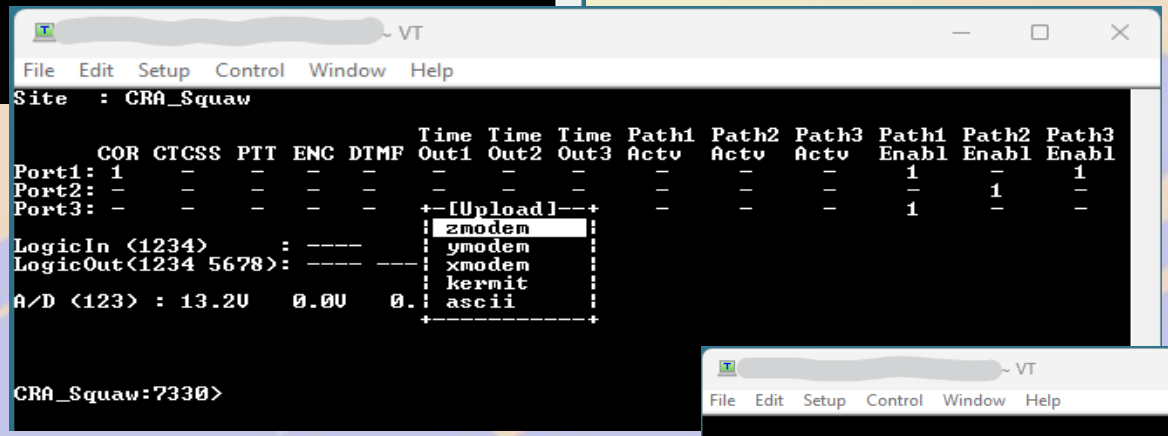
Ethernet to Serial Converters

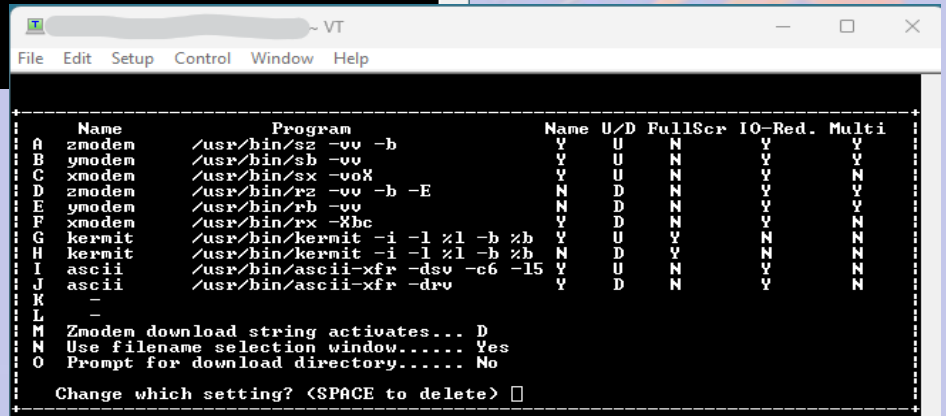
- Acts as a telnet-serial server
- Can also be a virtual serial port

Controller Access via Serial: SCOM 7330

Requires an IP to serial converter or site computer with serial port and minicom

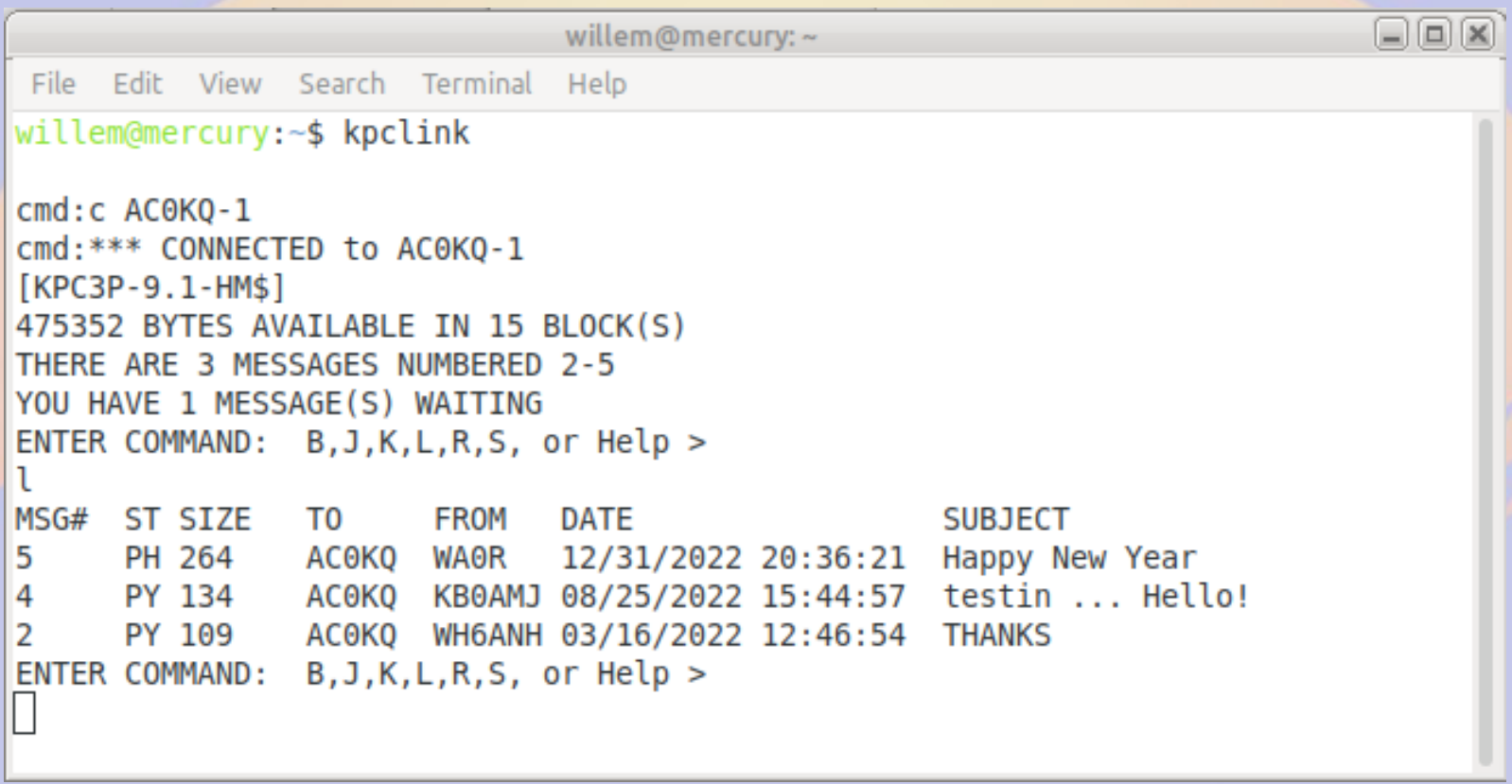






Easier than using tones for lengthy programs

Remote access to KPC-3+

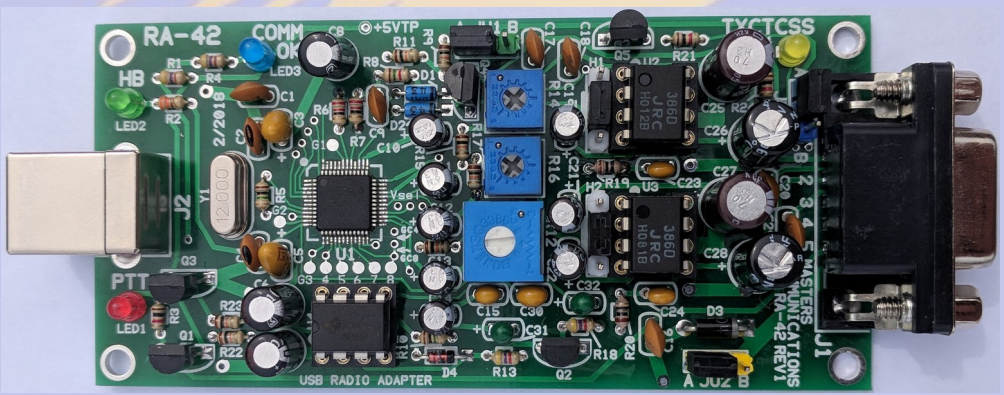


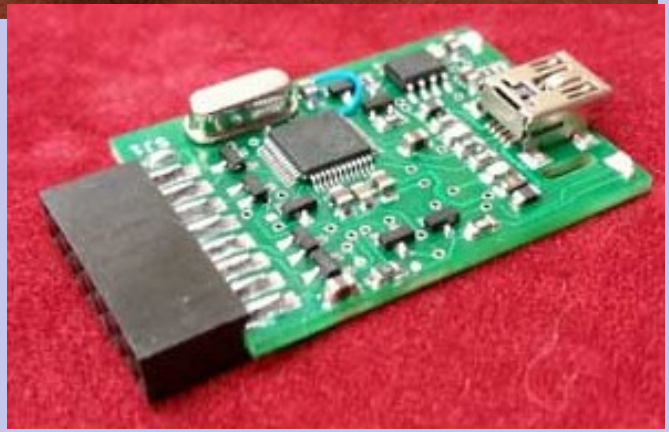
Repeater Linking

- IP permits linking of digital and analog repeaters
  - Native to digital radio such as DMR, D-Star, C4FM, P25
  - AllStarLink, IRLP, Echolink adds linking to analog
- IP linking is sensitive to network performance
  - UDP based which is a "best effort" protocol
  - latency cause delays
  - jitter cause syncing problems
  - digital modes tend to be more robust
    - P25 is very sensitive to jitter

USB Analog adapters for AllStarLink

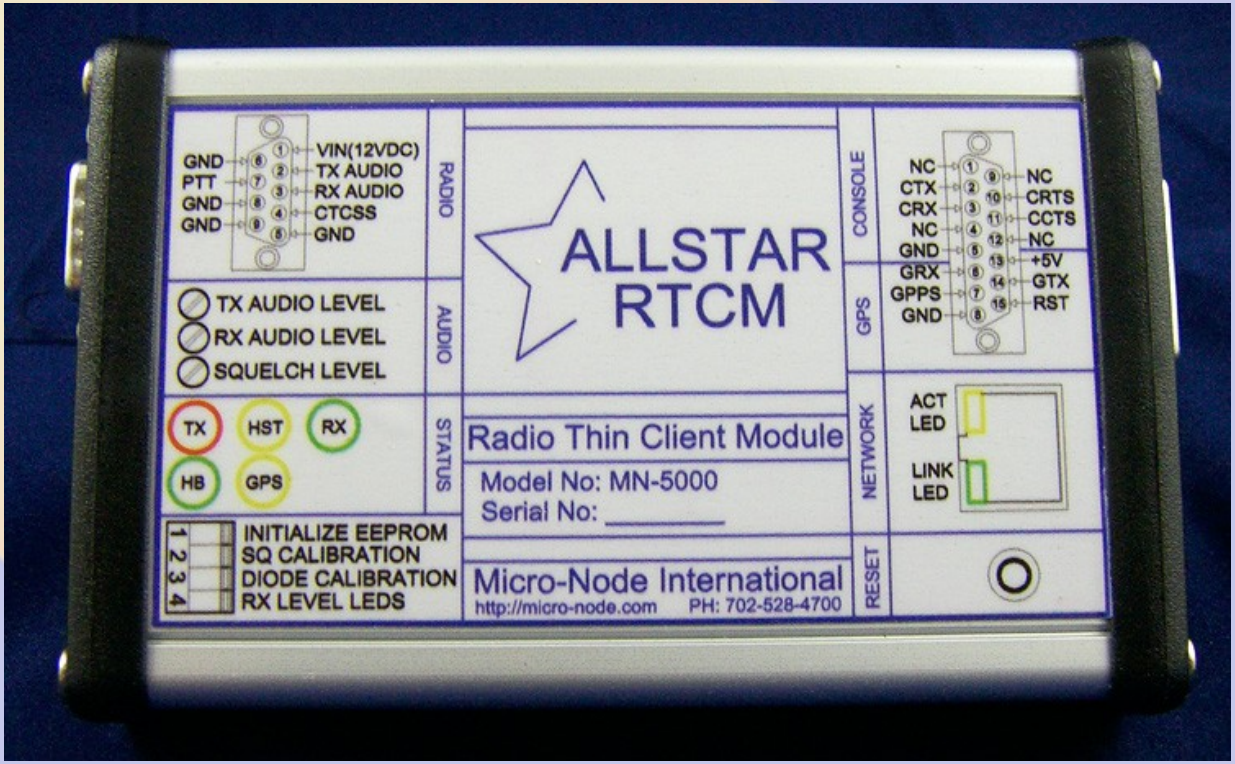
- Based on USB audio chips
- Should have isolated PTT and similar lines



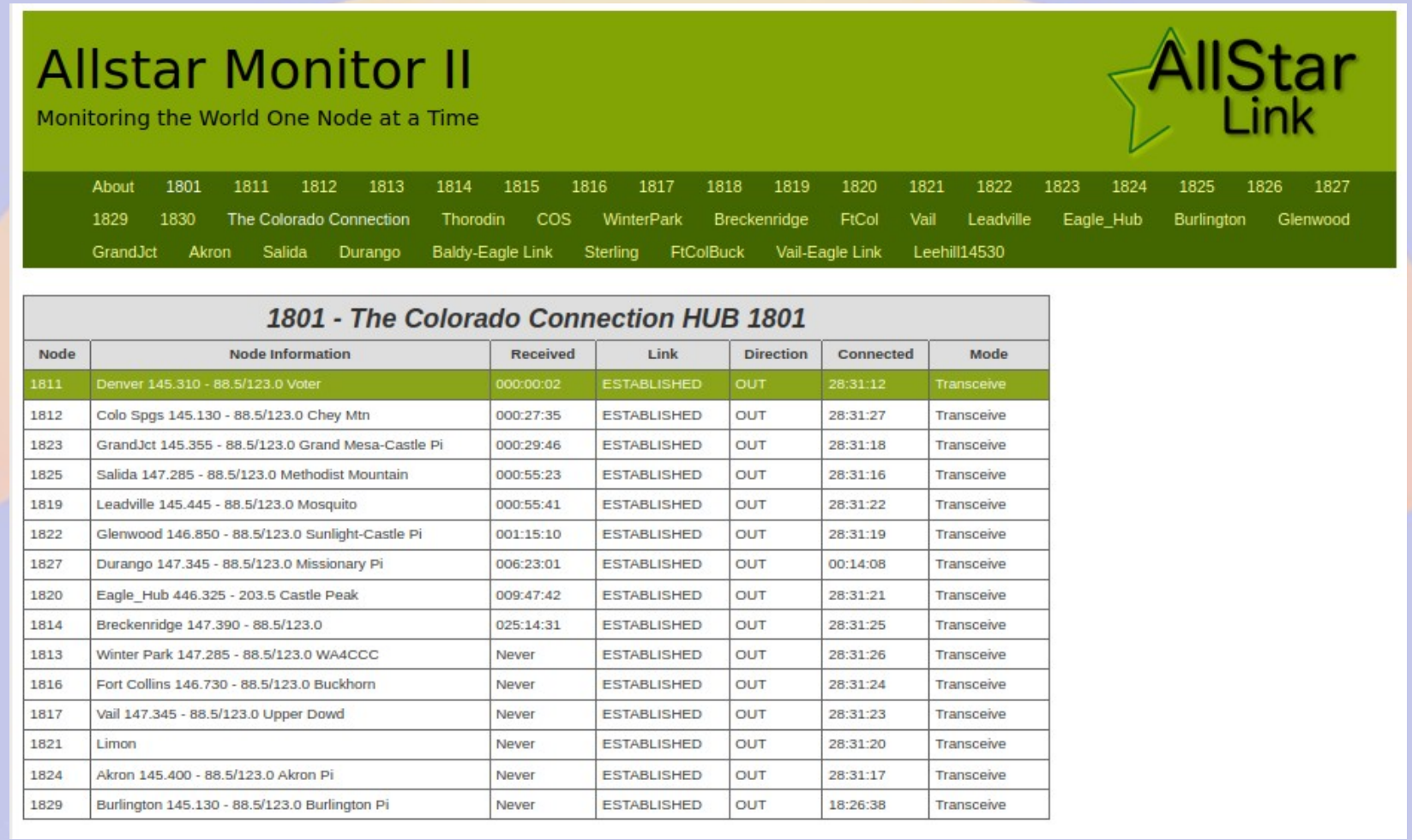


Radio Thin Client Module

- Stand alone PIC based radio interface
- GPS based timing for voting & "simulcast"
- Used by ColCon
  - Voter2K and Voter3K are coming soon



AllStarLink hub connect multiple site



Allstar Monitor II

Monitoring the World One Node at a Time

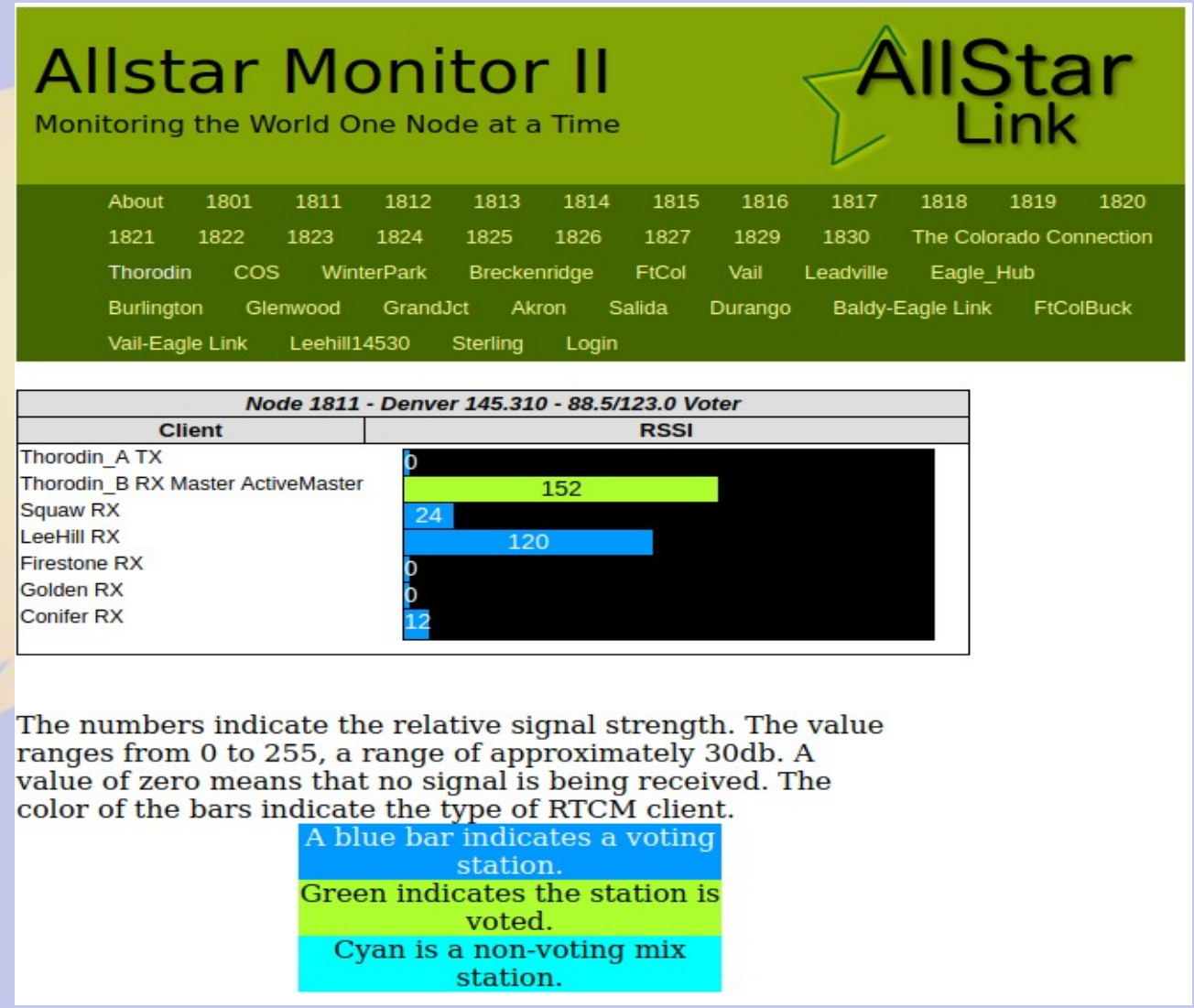
AllStar Link

About 1801 1811 1812 1813 1814 1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827
1829 1830 The Colorado Connection Thorodin COS WinterPark Breckenridge FtCol Vail Leadville Eagle_Hub Burlington Glenwood
GrandJct Akron Salida Durango Baldy-Eagle Link Sterling FtColBuck Vail-Eagle Link Leehill14530

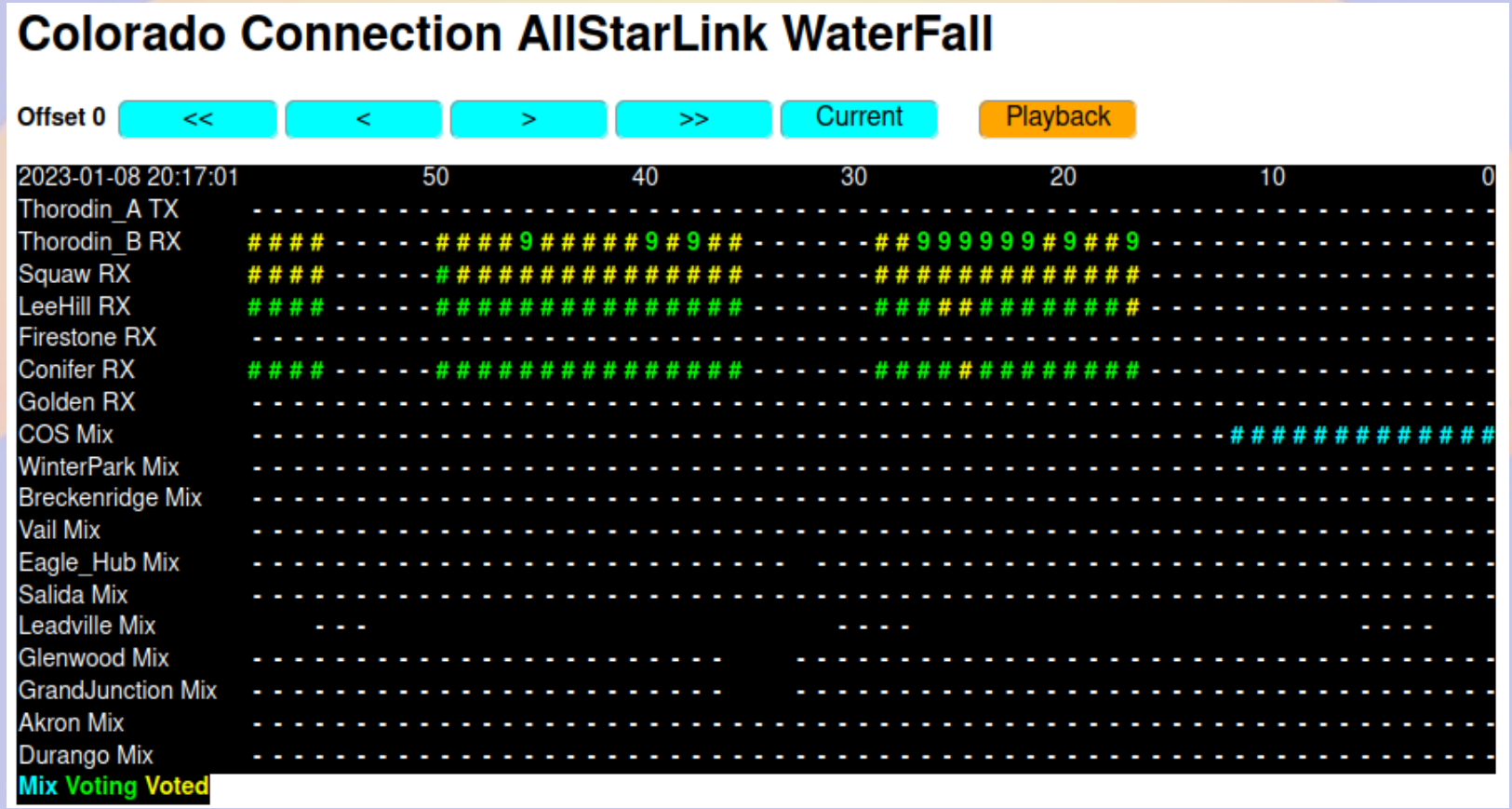
1801 - The Colorado Connection HUB 1801

Node	Node Information	Received	Link	Direction	Connected	Mode
1811	Denver 145.310 - 88.5/123.0 Voter	000:00:02	ESTABLISHED	OUT	28:31:12	Transceive
1812	Colo Spgs 145.130 - 88.5/123.0 Chey Mtn	000:27:35	ESTABLISHED	OUT	28:31:27	Transceive
1823	GrandJct 145.355 - 88.5/123.0 Grand Mesa-Castle Pi	000:29:46	ESTABLISHED	OUT	28:31:18	Transceive
1825	Salida 147.285 - 88.5/123.0 Methodist Mountain	000:55:23	ESTABLISHED	OUT	28:31:16	Transceive
1819	Leadville 145.445 - 88.5/123.0 Mosquito	000:55:41	ESTABLISHED	OUT	28:31:22	Transceive
1822	Glenwood 146.850 - 88.5/123.0 Sunlight-Castle Pi	001:15:10	ESTABLISHED	OUT	28:31:19	Transceive
1827	Durango 147.345 - 88.5/123.0 Missionary Pi	006:23:01	ESTABLISHED	OUT	00:14:08	Transceive
1820	Eagle_Hub 446.325 - 203.5 Castle Peak	009:47:42	ESTABLISHED	OUT	28:31:21	Transceive
1814	Breckenridge 147.390 - 88.5/123.0	025:14:31	ESTABLISHED	OUT	28:31:25	Transceive
1813	Winter Park 147.285 - 88.5/123.0 WA4CCC	Never	ESTABLISHED	OUT	28:31:26	Transceive
1816	Fort Collins 146.730 - 88.5/123.0 Buckhorn	Never	ESTABLISHED	OUT	28:31:24	Transceive
1817	Vail 147.345 - 88.5/123.0 Upper Dowd	Never	ESTABLISHED	OUT	28:31:23	Transceive
1821	Limon	Never	ESTABLISHED	OUT	28:31:20	Transceive
1824	Akron 145.400 - 88.5/123.0 Akron Pi	Never	ESTABLISHED	OUT	28:31:17	Transceive
1829	Burlington 145.130 - 88.5/123.0 Burlington Pi	Never	ESTABLISHED	OUT	18:26:38	Transceive

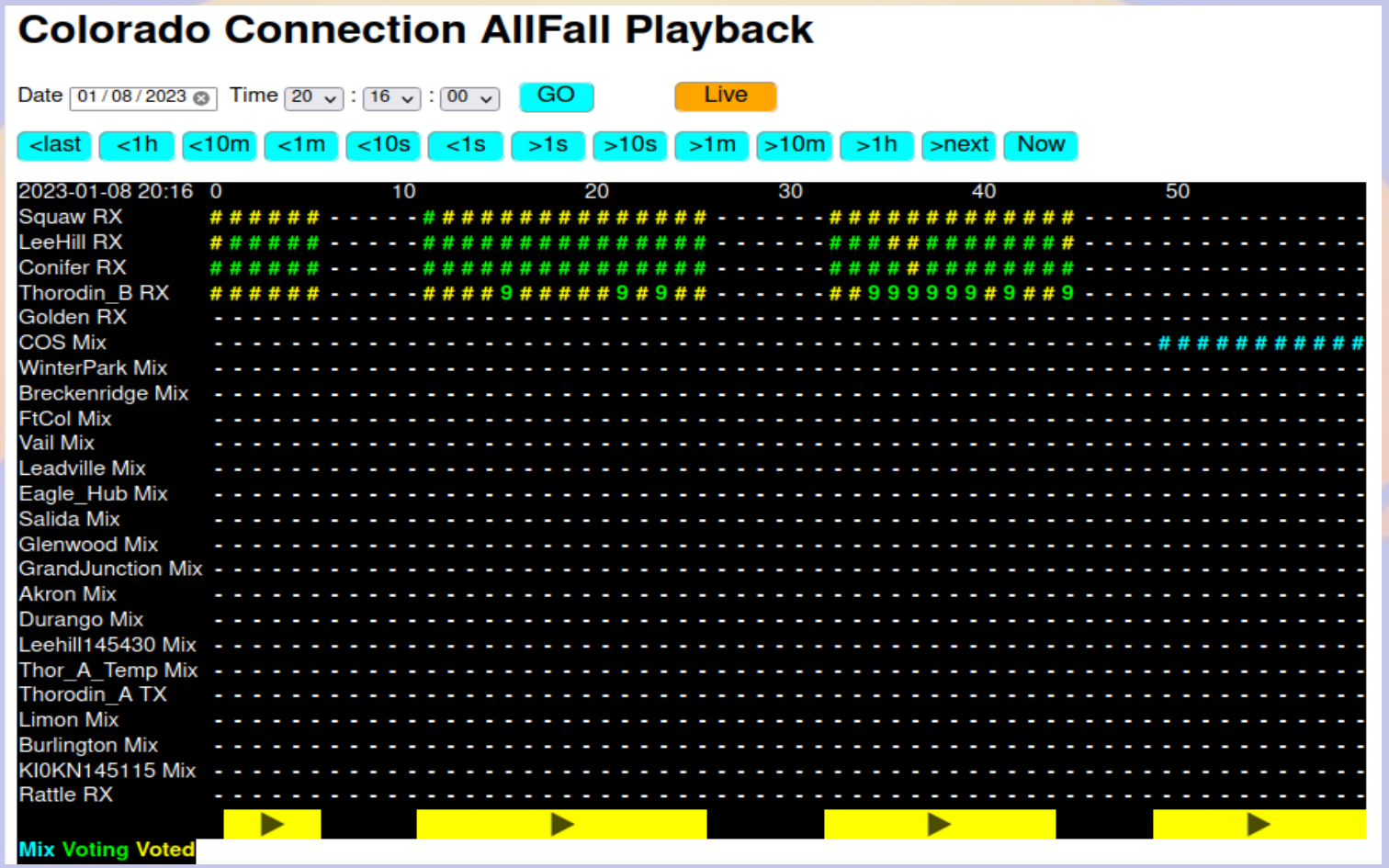
- Voting selects the strongest signal from available receivers
- AllMon2 shows the signal strength



AllFall is a web based waterfall for AllStarLink

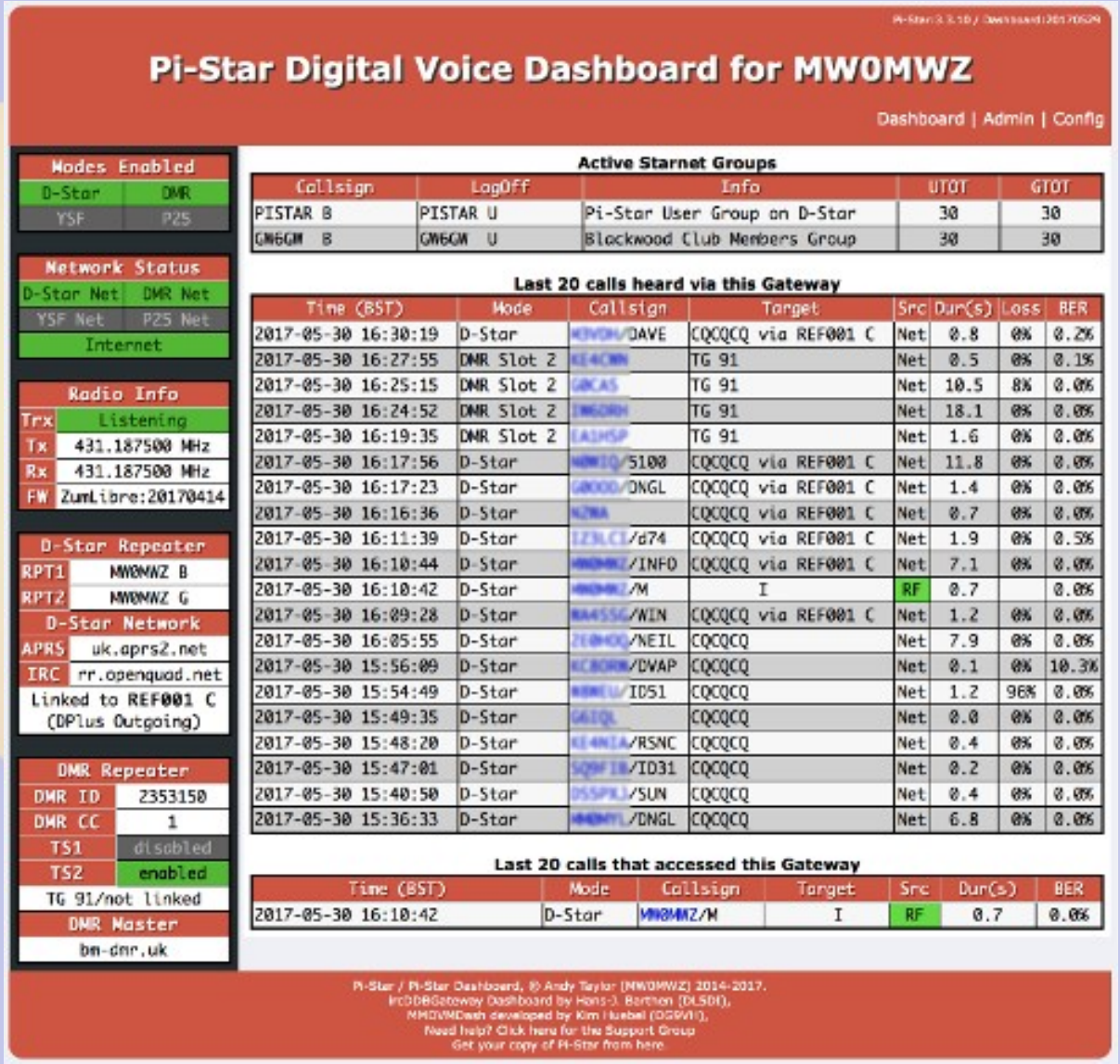


AllFall can store data and audio



Pi-Star

- Raspberry Pi based Multi-Mode Digital Voice
  - DMR
  - P25
  - C4FM
  - D-Star
  - NXDN
- Hotspot or repeater



DMR natively support IP

- Motorola IP Site Connect
- Master/Peer configuration
  - Limited to 16 repeaters
- Repeater Diagnostics and Control (RDAC)
  - Remote control of repeater
- RMHAM use c-Bridge
  - 3rd party DMR bridge

Repeaters linked via c-Bridge

RMHAM Northern	Eldorado UHF	CBridge 1	Akron UHF	Cheyenne UHF			
RMHAM Central	Thorodin UHF	CBridge 2	Squaw UHF	Badger UHF	Breck UHF	Vail UHF	Mosquito UHF
RMHAM Fremont Peak	Fremont UHF	Cbridge 3					
RMHAM Southern NEW	Almagre UHF	CBridge 4	Methodist UHF	Mancos UHF	Cavines UHF		
RMHAM Lookout UHF	Lookout VHF	CBridge 6					
RMHAM Genoa UHF	Genoa UHF	Cbridge 7					
RMHAM Sandia Crest UHF	0	Cbridge 9					
RMHAM Westcreek UHF	Westcreek UHF	CBridge 10					
RMHAM Devils Head UHF	Devilshead UHF	CBridge 11					
DMR Link	DMRLINK	CBridge 14					
RMHAM Rangely UHF	Rangely UHF	CBridge 16					
RMHAM QRV2 UHF	0	CBridge 20					
AUXCOM SOW1	0	CBridge 22					
RMHAM Almagre VHF	Almagre VHF	CBridge 25					
RMHAM Squaw VHF	Squaw VHF	CBridge 26					
RMHAM Lookout VHF	Lookout VHF	CBridge 27					
Triple C - Monitor Only	TplC Thor	CBridge 49	TplC Squaw				

Green indicates the repeater that is receiving the signal.

Red line indicates transmitting

Yellow indicates offline repeater

c-Bridge diagnostics

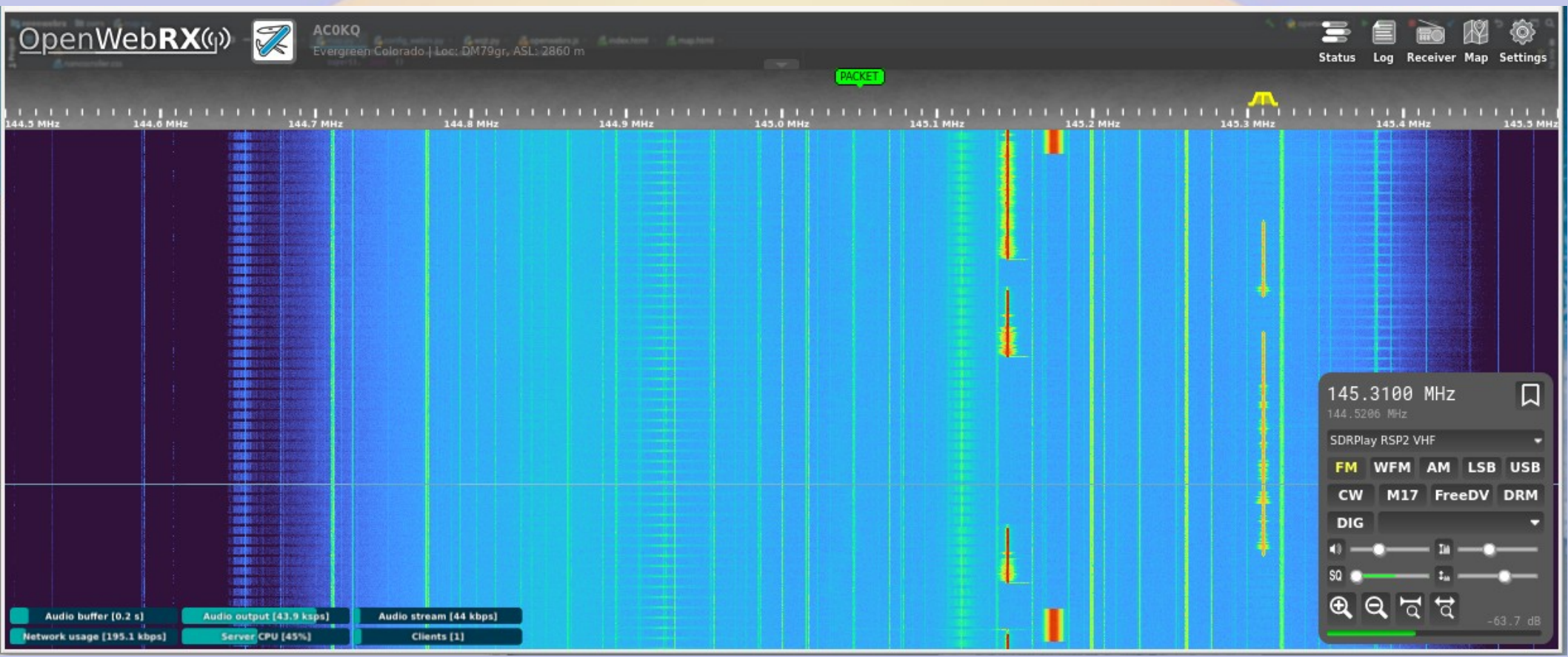
History

10:29:47.332 Apr 2	7.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-95.6	CO-RMHR	0.8%
10:29:33.652 Apr 2	13.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-95.7	CO-RMHR	0.9%
10:28:50.256 Apr 2	40.0	19	RMHAM Westcreek TS1 TG700	g	310846	1108133	Westcreek UHF	N0XCR - Jeff M - Pueblo Colorado United States -- 1108133	Rocky Mt TG700	700	-91.4	CO-RMHR	0.0%
10:28:46.723 Apr 2	0.0	19	RMHAM Westcreek TS1 TG700	g	310846	1108133	Westcreek UHF	N0XCR - Jeff M - Pueblo Colorado United States -- 1108133	Rocky Mt TG700	700	-90.5	CO-RMHR	0.0%
10:28:43.117 Apr 2	2.0	19	RMHAM Westcreek TS1 TG700	g	310846	1108133	Westcreek UHF	N0XCR - Jeff M - Pueblo Colorado United States -- 1108133	Rocky Mt TG700	700	-91.2	CO-RMHR	3.5%
10:28:25.730 Apr 2	8.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-87.3	CO-RMHR	1.0%
10:28:24.289 Apr 2	1.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-95.8	CO-RMHR	0.0%
10:28:22.850 Apr 2	1.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-96.3	CO-RMHR	3.2%
10:28:05.373 Apr 2	13.0	19	RMHAM Westcreek TS1 TG700	g	310846	1108133	Westcreek UHF	N0XCR - Jeff M - Pueblo Colorado United States -- 1108133	Rocky Mt TG700	700	-92.0	CO-RMHR	0.0%
10:27:57.235 Apr 2	3.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-90.6	CO-RMHR	0.0%
10:27:42.517 Apr 2	11.0	19	RMHAM Westcreek TS1 TG700	g	310846	3128785	Westcreek UHF	W0DFU - Dan - Bailey Colorado United States -- 3128785	Rocky Mt TG700	700	-94.9	CO-RMHR	0.0%
10:27:34.553 Apr 2	6.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-93.8	CO-RMHR	2.7%
10:27:24.231 Apr 2	1.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-100.1	CO-RMHR	3.1%
10:27:07.032 Apr 2	14.0	19	RMHAM Westcreek TS1 TG700	g	310846	3128785	Westcreek UHF	W0DFU - Dan - Bailey Colorado United States -- 3128785	Rocky Mt TG700	700	-91.9	CO-RMHR	0.0%
10:26:49.189 Apr 2	14.0	7	RMHAM Southern TS1 TG700	g	310825	3108507	Methodist UHF	KD0MRC - James - Buena Vista Colorado United States -- 3108507	Rocky Mt TG700	700	-109.6	CO-RMHR	0.3%
10:26:26.025 Apr 2	20.0	19	RMHAM Westcreek TS1 TG700	g	310846	3128785	Westcreek UHF	W0DFU - Dan - Bailey Colorado United States -- 3128785	Rocky Mt TG700	700	-95.0	CO-RMHR	0.0%

Software Defined Radio (SDR)

- Often USB based
- Stream signals via IP
  - IQ stream
  - Digital audio
- Software
  - RTL-SDR
  - OpenWebRX
  - GnuRadio
  - Direwolf (packet)

OpenWebRX

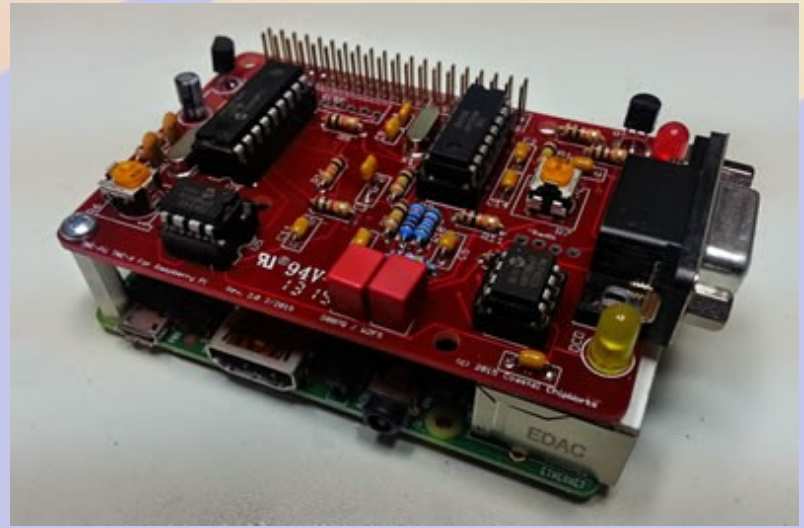

OpenWebRX
AC0KQ
Evergreen Colorado | Loc: DM79gr, ASL: 2860 m
Status
Log
Receiver
Map
Settings
PACKET
144.5 MHz
144.6 MHz
144.7 MHz
144.8 MHz
144.9 MHz
145.0 MHz
145.1 MHz
145.2 MHz
145.3 MHz
145.4 MHz
145.5 MHz
145.3100 MHz
144.5206 MHz
SDRPlay RSP2 VHF
FM
WFM
AM
LSB
USB
CW
M17
FreeDV
DRM
DIG
SQ
-63.7 dB
Audio buffer [0.2 s]
Audio output [43.9 ksps]
Audio stream [44 kbps]
Network usage [195.1 kbps]
Server CPU [45%]
Clients [1]

Remote Base

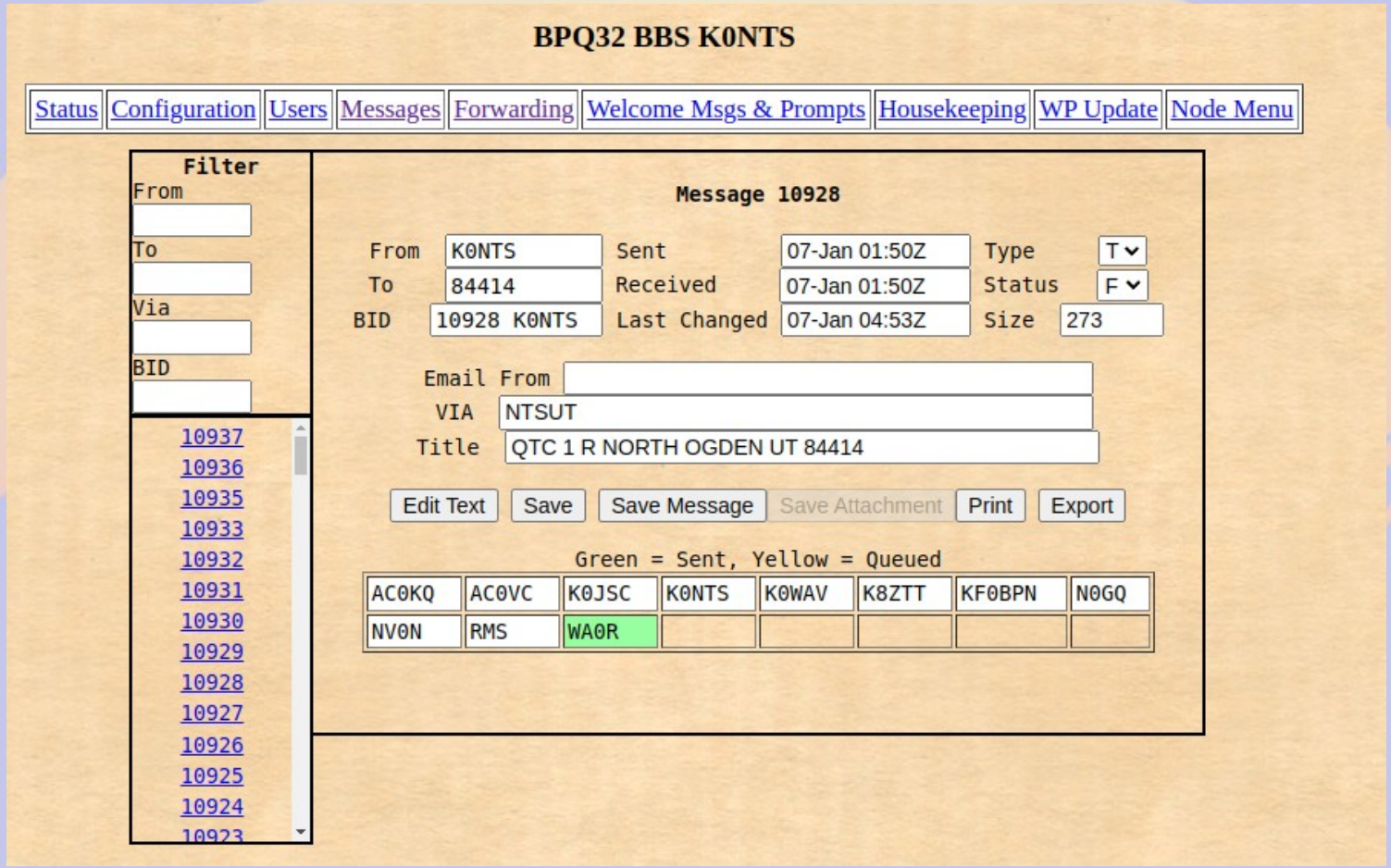
- Remote control of a radio
- Software or hardware remote
- AllStarLink supports remote base with limited control

iGate

- Forward APRS to aprs.fi
  - Internal or external radio
- BPQ can also be an iGate

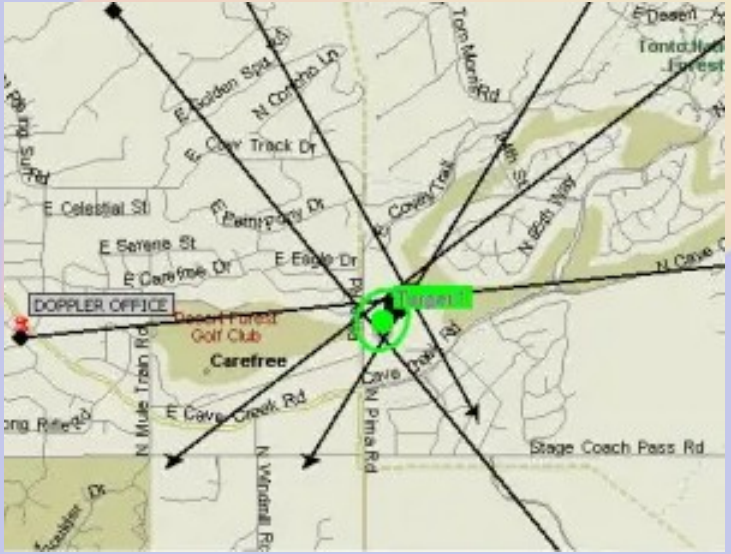


BPQ, WinLink & NTSGW



Direction Finding

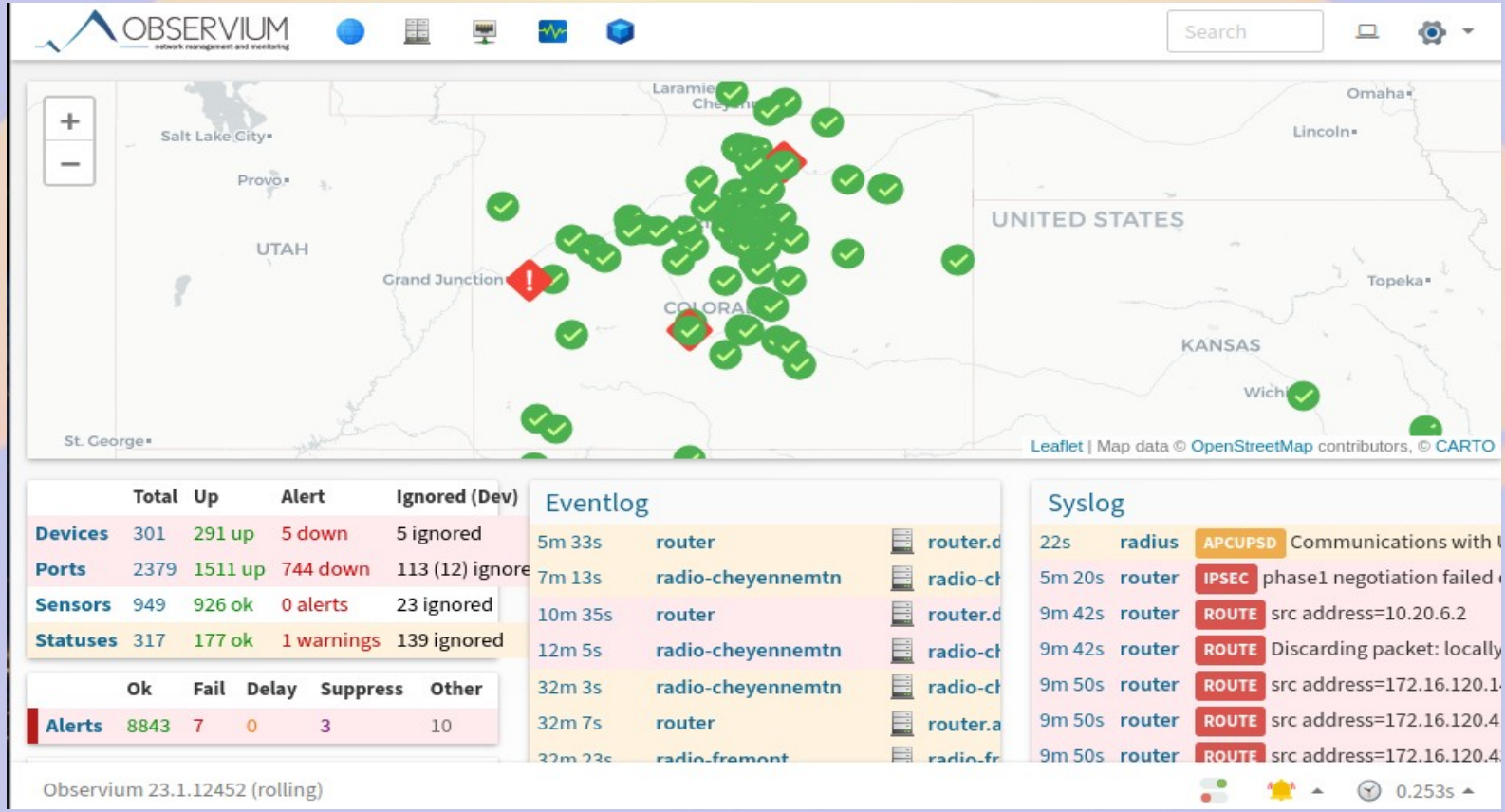
- DDF7000 Doppler
- Links multiple units and mapping software with IP



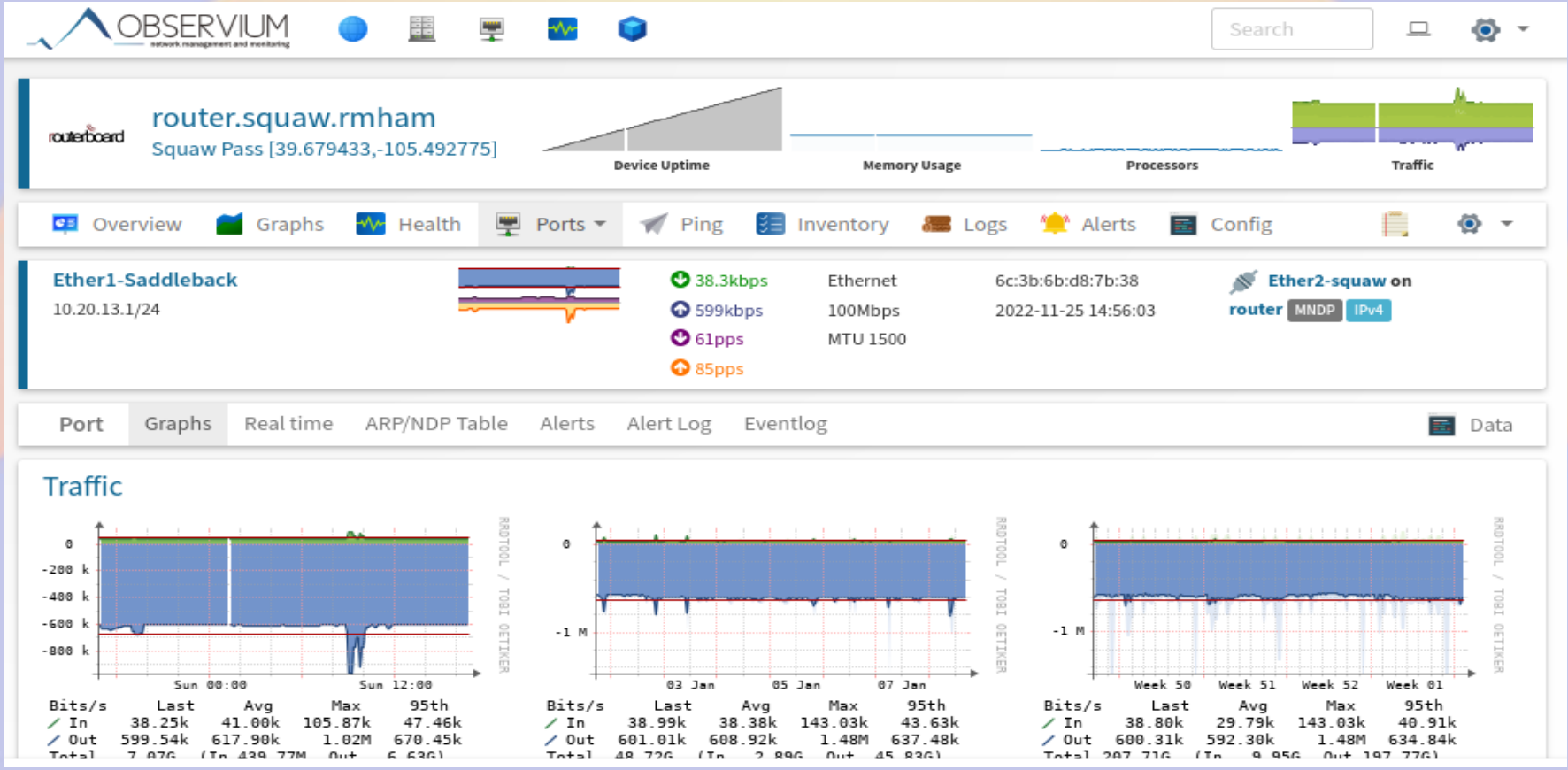
Network Management Tools

- cping
  - Concurrent ping
- SmokePing
  - Graphing ping
- Observium/Nagios/LibreNMS/…
  - Network Management Systems
- RANCID
  - Network device backup

Observium

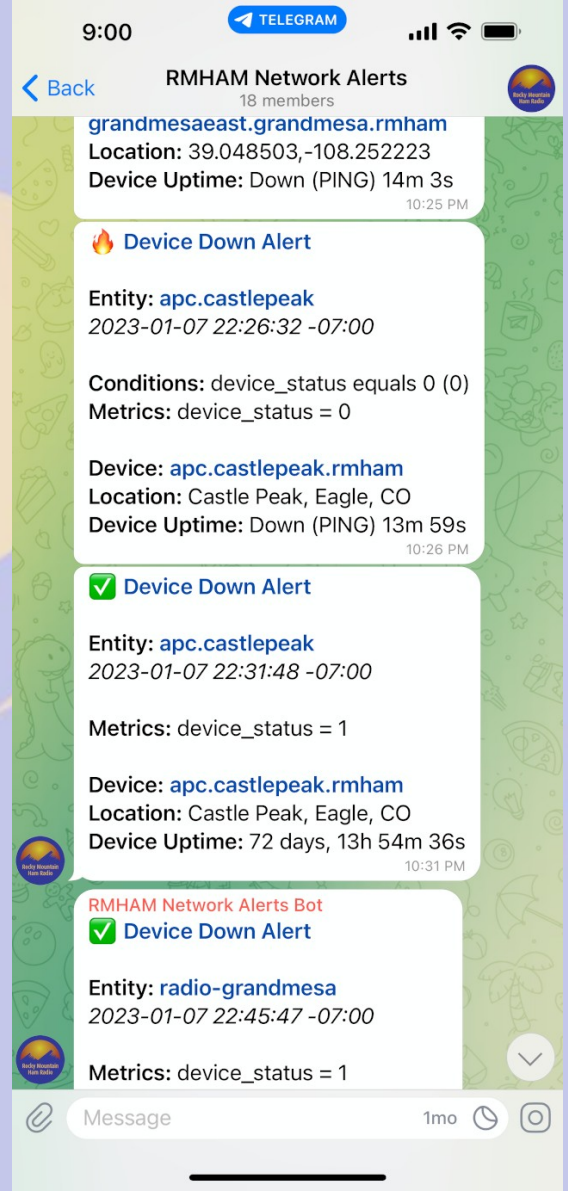

OBSERVIUM
Search
Salt Lake City
Provo
UTAH
Grand Junction
COLORADO
UNITED STATES
Omaha
Lincoln
Topeka
KANSAS
St. George
Leaflet | Map data © OpenStreetMap contributors, © CARTO
Total Up Alert Ignored (Dev)
Devices 301 291 up 5 down 5 ignored
Ports 2379 1511 up 744 down 113 (12) ignore
Sensors 949 926 ok 0 alerts 23 ignored
Statuses 317 177 ok 1 warnings 139 ignored
Ok Fail Delay Suppress Other
Alerts 8843 7 0 3 10
Eventlog
5m 33s router
7m 13s radio-cheyennemtn
10m 35s router
12m 5s radio-cheyennemtn
32m 3s radio-cheyennemtn
32m 7s router
Syslog
22s radius APCUPSD Communications with
5m 20s router IPSEC phase1 negotiation failed
9m 42s router ROUTE src address=10.20.6.2
9m 42s router ROUTE Discarding packet: locally
9m 50s router ROUTE src address=172.16.120.1
9m 50s router ROUTE src address=172.16.120.4
9m 50s router ROUTE src address=172.16.120.4
Observium 23.1.12452 (rolling)
0.253s

Observium Port Status

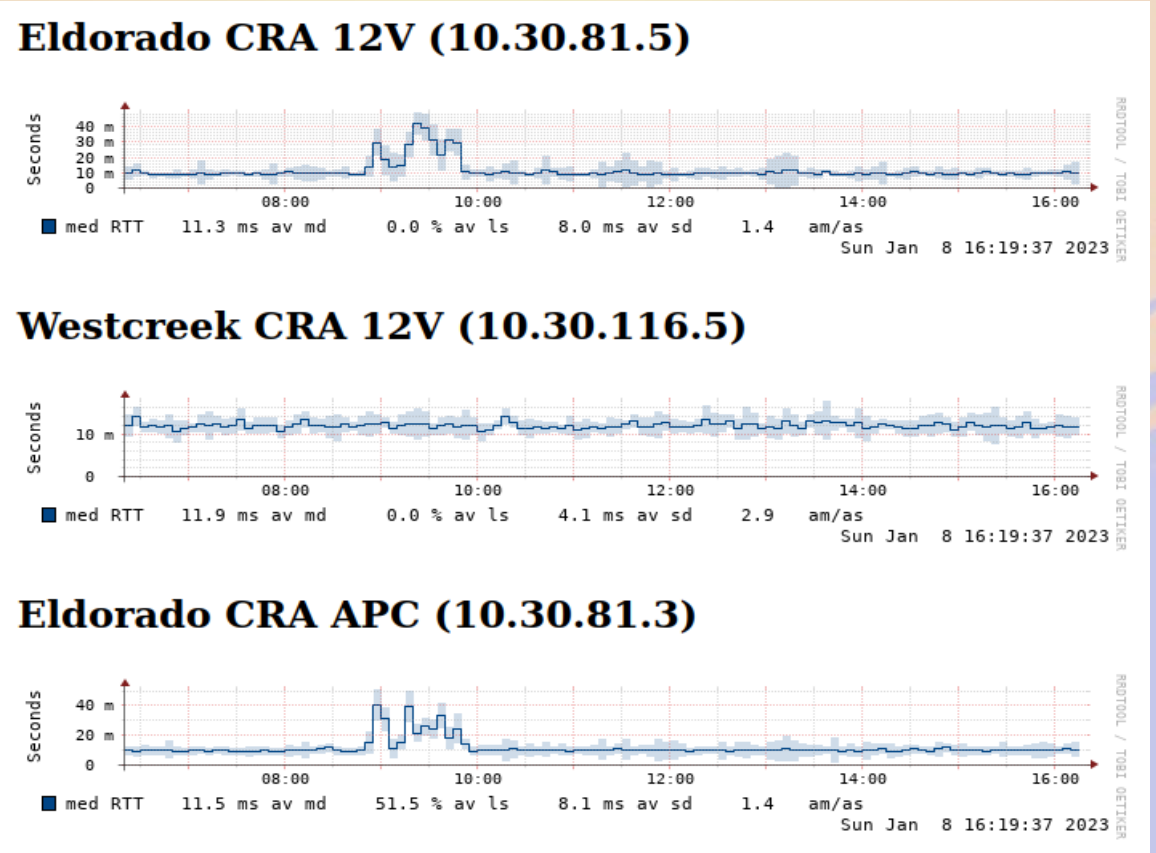


System Alerts

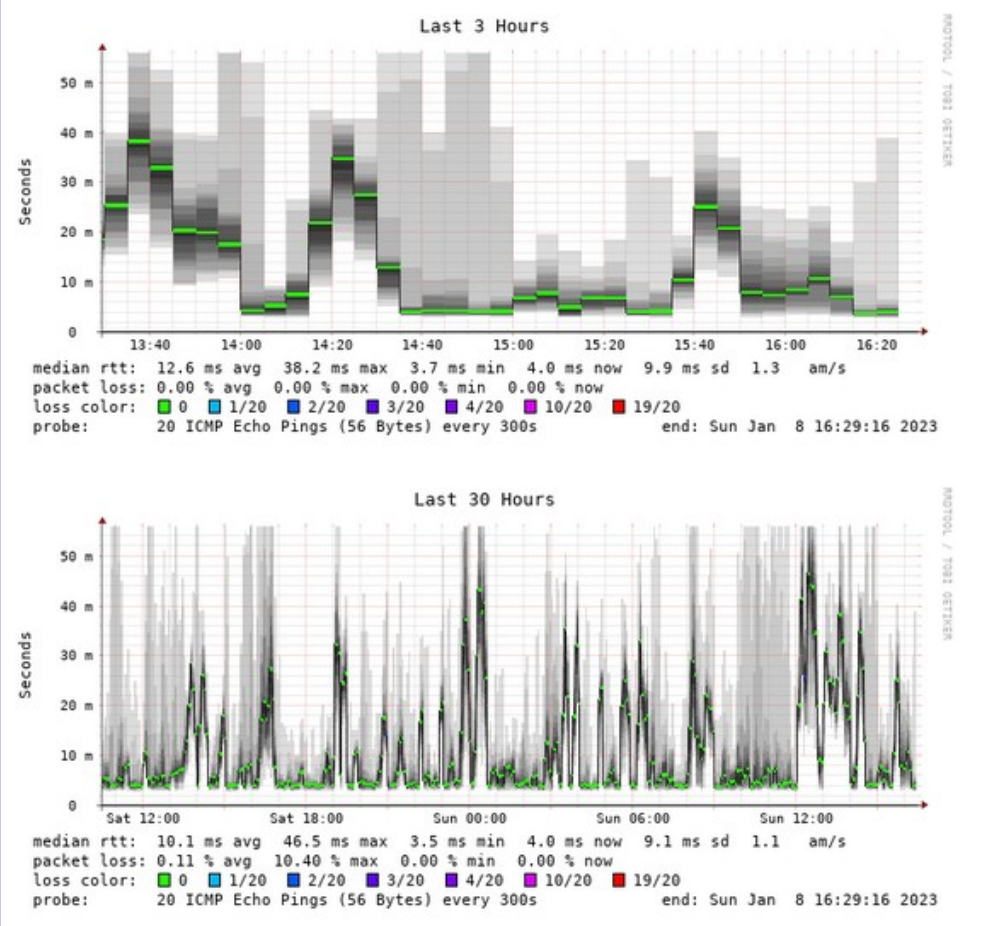
- Alert methods
  - Email
  - Telegram
- Alert on
  - power out
  - port down
  - device down
- Important to have adjustable sensitivity

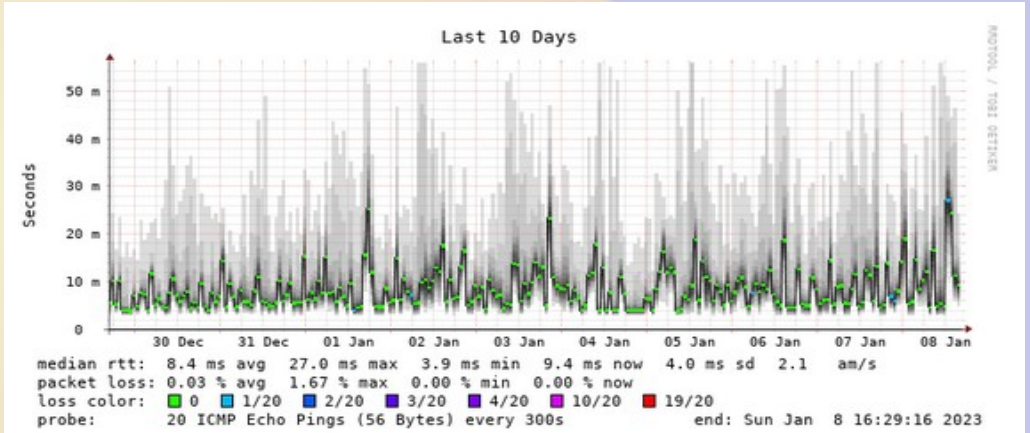


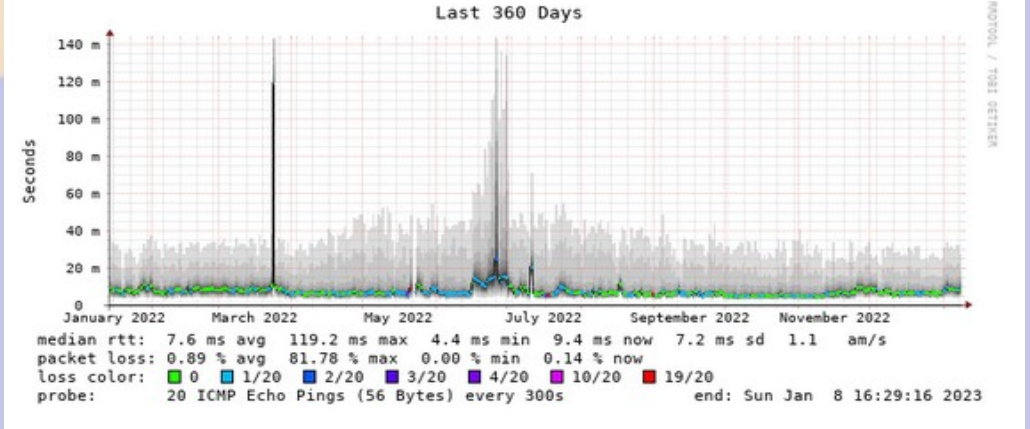
Smokeping


Eldorado CRA 12V (10.30.81.5)
Seconds
40 m
30 m
20 m
10 m
0
08:00
10:00
12:00
14:00
16:00
med RTT 11.3 ms av md 0.0 % av ls 8.0 ms av sd 1.4 am/as
Sun Jan 8 16:19:37 2023
RRDTOOL / TOBI OETIKER
Westcreek CRA 12V (10.30.116.5)
Seconds
10 m
0
08:00
10:00
12:00
14:00
16:00
med RTT 11.9 ms av md 0.0 % av ls 4.1 ms av sd 2.9 am/as
Sun Jan 8 16:19:37 2023
RRDTOOL / TOBI OETIKER
Eldorado CRA APC (10.30.81.3)
Seconds
40 m
20 m
0
08:00
10:00
12:00
14:00
16:00
med RTT 11.5 ms av md 51.5 % av ls 8.1 ms av sd 1.4 am/as
Sun Jan 8 16:19:37 2023
RRDTOOL / TOBI OETIKER

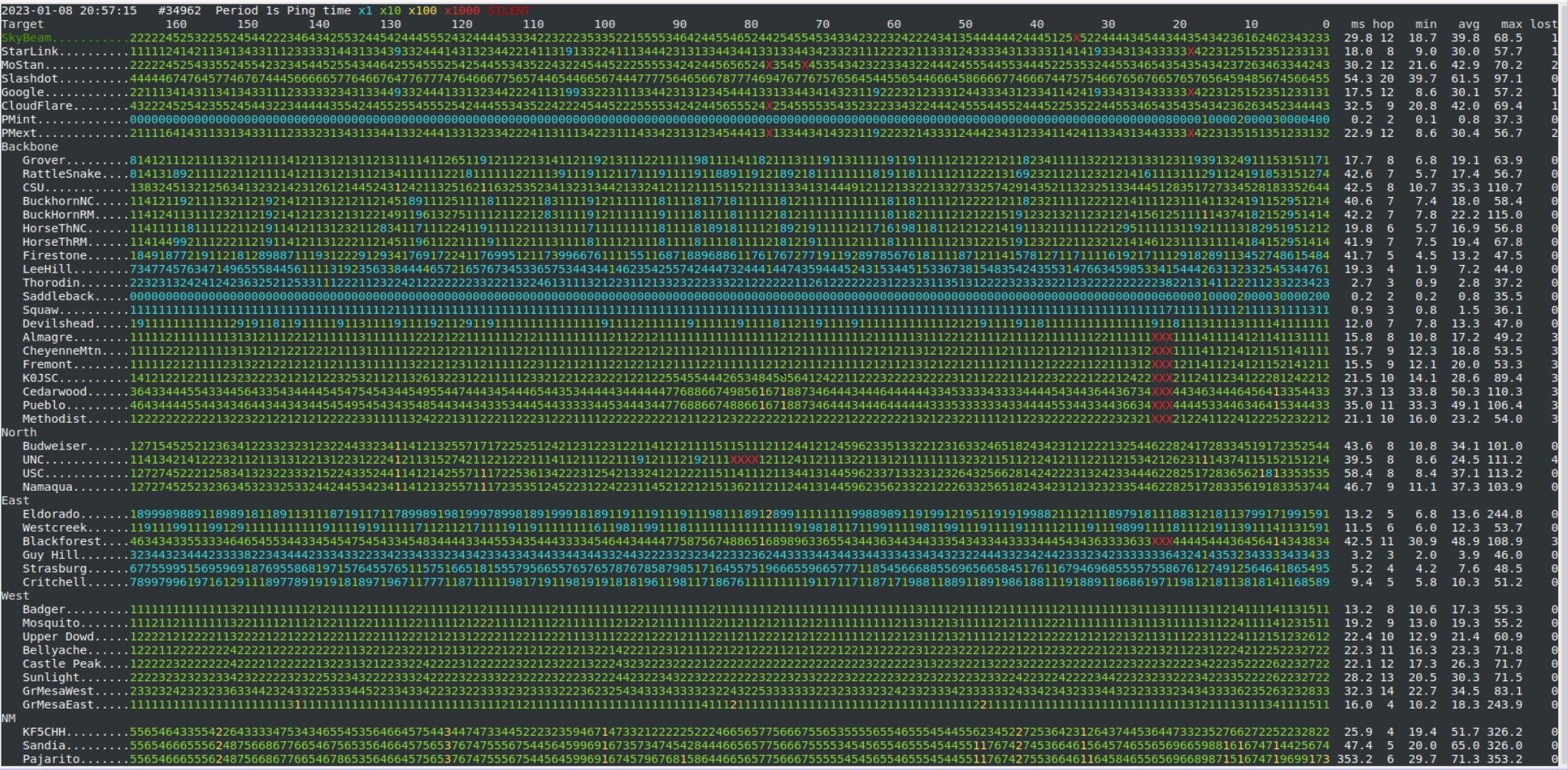
SmokePing Detail







cping


2023-01-08 20:57:15 #34962 Period 1s Ping time x1 x10 x100 x1000 SILENT
Target 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ms hop min avg max lost
SkyBeam 29.8 12 18.7 39.8 68.5 1
StarLink 18.0 8 9.0 30.0 57.7 1
MoStan 30.2 12 21.6 42.9 70.2 2
Slashdot 54.3 20 39.7 61.5 97.1 0
Google 17.5 12 8.6 30.1 57.2 1
CloudFlare 32.5 9 20.8 42.0 69.4 1
PMint 0.2 2 0.1 0.8 37.3 0
PMext 22.9 12 8.6 30.4 56.7 2
Backbone
Grover 17.7 8 6.8 19.1 63.9 0
RattleSnake 42.6 7 5.7 17.4 56.7 0
CSU 42.5 8 10.7 35.3 110.7 0
BuckhornNC 40.6 7 7.4 18.0 58.4 0
BuckHornRM 42.2 7 7.8 22.2 115.0 0
HorseThNC 19.8 6 5.7 16.9 56.8 0
HorseThRM 41.9 7 7.5 19.4 67.8 0
Firestone 41.7 5 4.5 13.2 47.5 0
LeeHill 19.3 4 1.9 7.2 44.0 0
Thorodin 2.7 3 0.9 2.8 37.2 0
Saddleback 0.2 2 0.2 0.8 35.5 0
Squaw 0.9 3 0.8 1.5 36.1 0
Devilshead 12.0 7 7.8 13.3 47.0 0
Almagre 15.8 8 10.8 17.2 49.2 3
CheyenneMtn 15.7 9 12.3 18.8 53.5 3
Fremont 15.5 9 12.1 20.0 53.3 3
K0JSC 21.5 10 14.1 28.6 89.4 3
Cedarwood 37.3 13 33.8 50.3 110.3 3
Pueblo 35.0 11 33.3 49.1 106.4 3
Methodist 21.1 10 16.0 23.2 54.0 3
North
Budweiser 43.6 8 10.8 34.1 101.0 0
UNC 39.5 8 8.6 24.5 111.2 4
USC 58.4 8 8.4 37.1 113.2 0
Namaqua 46.7 9 11.1 37.3 103.9 0
East
Eldorado 13.2 5 6.8 13.6 244.8 0
Westcreek 11.5 6 6.0 12.3 53.7 0
Blackforest 42.5 11 30.9 48.9 108.9 3
Guy Hill 3.2 3 2.0 3.9 46.0 0
Strasburg 5.2 4 4.2 7.6 48.5 0
Critchell 9.4 5 5.8 10.3 51.2 0
West
Badger 13.2 8 10.6 17.3 55.3 0
Mosquito 19.2 9 13.0 19.3 55.2 0
Upper Dowd 22.4 10 12.9 21.4 60.9 0
Bellyache 22.3 11 16.3 23.3 71.8 0
Castle Peak 22.1 12 17.3 26.3 71.7 0
Sunlight 28.2 13 20.5 30.3 71.5 0
GrMesaWest 32.3 14 22.7 34.5 83.1 0
GrMesaEast 16.0 4 10.2 18.3 243.9 0
NM
KF5CHH 25.9 4 19.4 51.7 326.2 0
Sandia 47.4 5 20.0 65.0 326.0 0
Pajarito 353.2 6 29.7 71.3 353.2 0

Questions?