

Managed MikroTik Solutions for Home Networks

MikroTik MUM – Dallas 2016
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Background

- ▶ Engineer – BSEE
- ▶ MikroTik Certified Consultant and Trainer

- ▶ WISP TRACON LLC
 - Partner with Andis Arins
 - Solutions Training and Consulting Company

- ▶ Winters Broadband LLC
 - California based WISP
 - Founded 2002

Typical Home Network Provisioning Steps

- ▶ Request for Service
 - Get customer details
 - Schedule installation call
- ▶ Installation
 - Install CPE
 - Where? Can you deliver service?
- ▶ Support
 - Service calls
 - Demarcation Point
 - What equipment do you support?
 - Problem resolution
 - Truck roll?
 - What do you charge?

Welcome to the Last 100 feet

- ▶ The service was installed, the customer was happy, then you get a support call
 - Service is not working
 - Service is slow
 - Service is intermittent
 - Streaming video buffers
 - New device is not working
 - Unable to access camera from Internet
 - No service in a section of home

Analyzing the Problems

- ▶ Service is not working
 - ✓ CPE online?
 - ✓X Customer device connected to CPE?
- ▶ Service is slow
 - ✓ Speed/Quality of customer connection?
 - ? Customer bandwidth utilization?
- ▶ New device is not working
 - ✓ Other devices working?
 - ✓ Customer problem 😊

Analyzing the Problems

- ▶ Unable to access camera from Internet
 - ✓ Port forwarding configured on CPE?
 - ✓ Customer problem 😊
- ▶ No service in a section of home
 - ✓ Customer problem 😊

Solving Home Network Problems

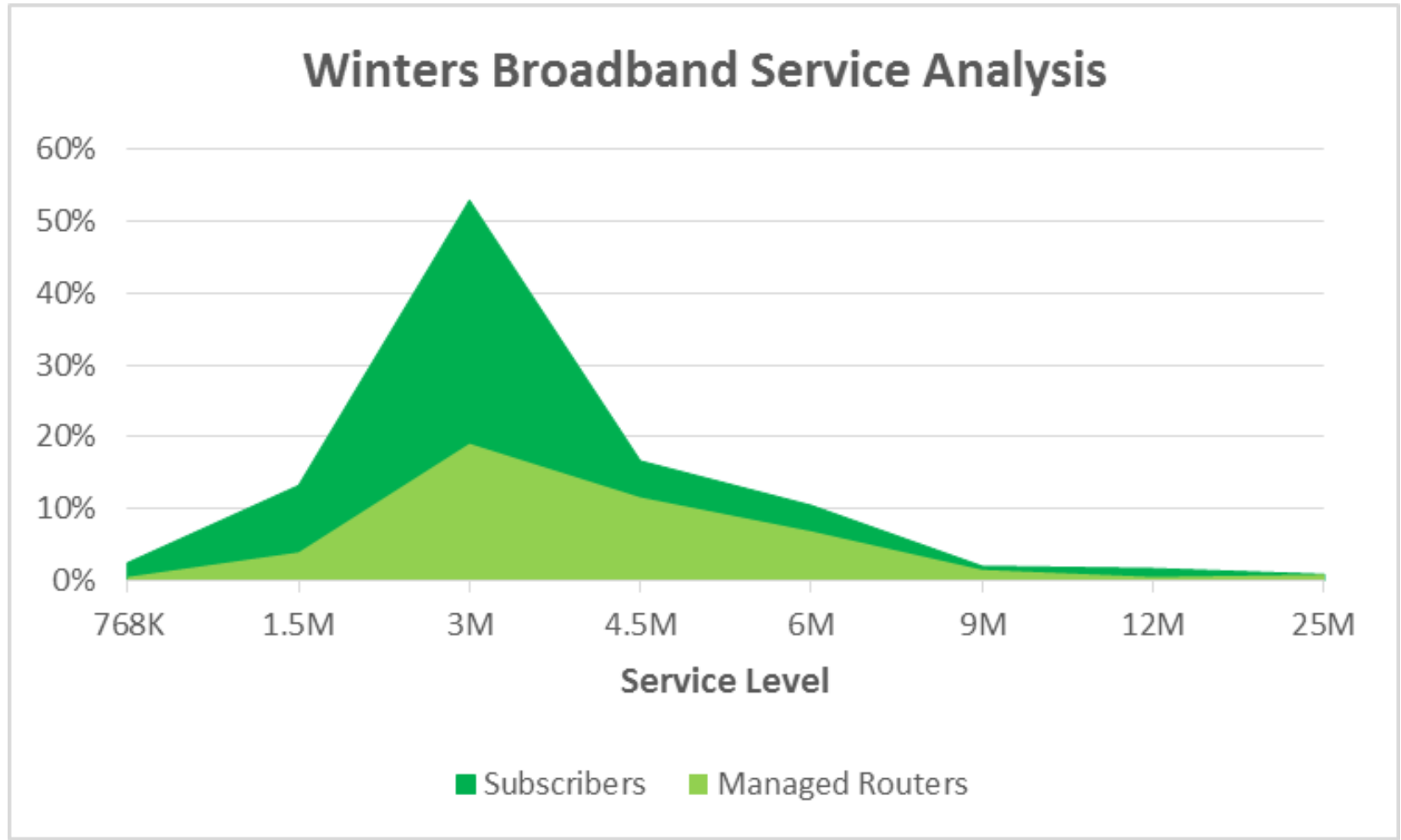
- ▶ Tell customer issue is with his home network
 - Unhappy customer
 - Likely to consider alternative options
- ▶ Provide support for his home network
 - How many different types of equipment are you going to support?
 - Does the equipment have the necessary diagnostics?
 - Are you going to make money doing it?

Home Network Provisioning

- ▶ Request for Service
 - Determine customer requirements
 - **Field Test**
 - **Service plan with upgrade potential**
 - **Installation work order**



Planned Upgrade Strategy



Home Network Provisioning

- ▶ Request for Service
 - Determine customer requirements
 - **Field Test**
 - **Service plan with upgrade potential**
 - **Installation work order**
- ▶ Installation
 - Install CPE
 - **Do bandwidth test, log results**



Streaming Video

The biggest bandwidth utilization application

- ▶ **Netflix**

The Internet download speed requirements and recommendations for playing movies and TV shows on the Netflix web site are as follows:

- 0.5 Megabits per second – Required broadband connection speed

- 1.5 Megabits per second – Recommended broadband connection speed

- 3 Megabits per second – Recommended for SD quality

- 5 Megabits per second – Recommended for HD quality

- 25 Megabits per second – Recommended for Ultra HD quality

- ▶ **Wide array of video streaming services**

- Netflix, Amazon, Hulu, YouTube, HBO, CBS, ...

Services & Features

- ▶ Residential Services
 - Asymmetric service
 - Entry level option at 1.5 Mbps
 - Upgrade path to 25 Mbps
 - Month to month contract
- ▶ Business Services
 - Symmetric service
 - Speeds up to 100 Mbps
 - 1 to 3 year contract
- ▶ Features
 - No data caps
 - 90% CIR
 - Static IP address
 - Low latency

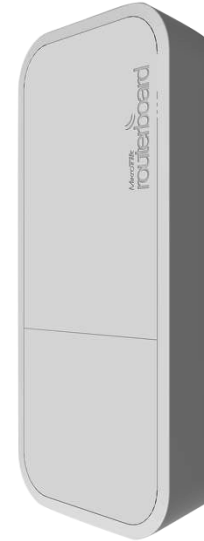
Solution – Managed Router

- ▶ Sell customer a router which you manage
 - Router Features
 - Diagnostic tools
 - Learning curve
 - Remote Access
 - Eliminate truck rolls
 - Minimize support time
 - Annual Fee
 - Additional revenue
 - Reduced operating costs

MikroTik Products



hAP ac lite



wAP ac



cAP

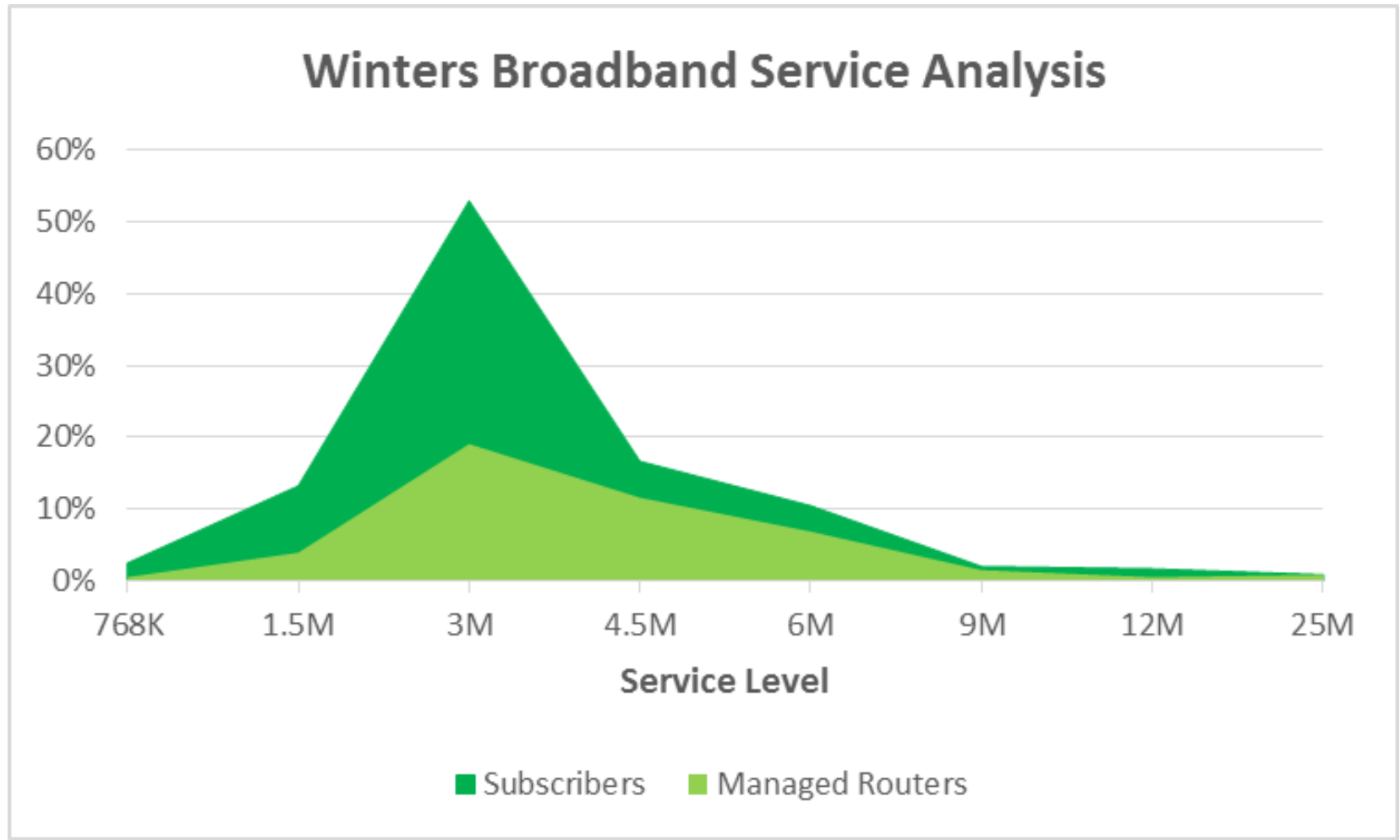


mAP 2n

Winters Broadband

- ▶ Introduced managed router service in 2011
 - MikroTik router
 - Was RB751 now RB952, cAP, wAP & mAP
 - 74% of subscribers
 - RouterOS device – same as Data Center and Towers
 - Extensive diagnostics
 - Incentives
 - No charge speed upgrade
 - Managed service
 - Firewall
 - Port forwarding
 - Bandwidth control

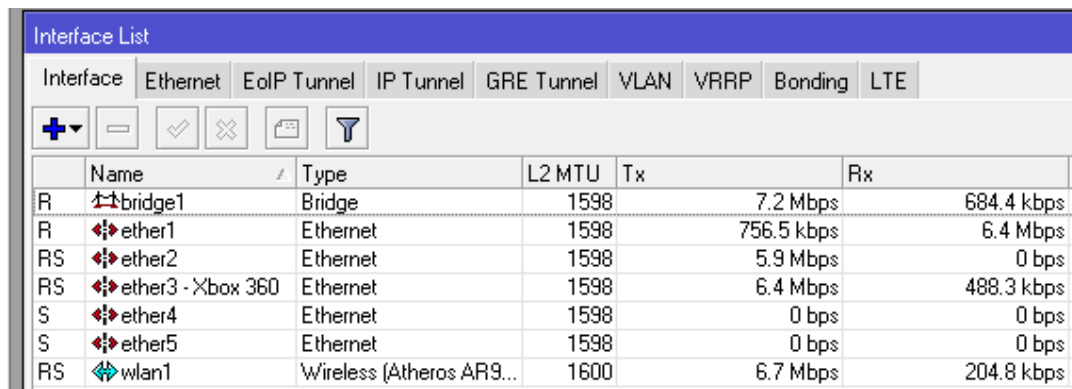
Planned Upgrade Strategy



Reviewing those Service Calls

Service is not working

- ▶ Can you access the managed router?
 - Connected clients?



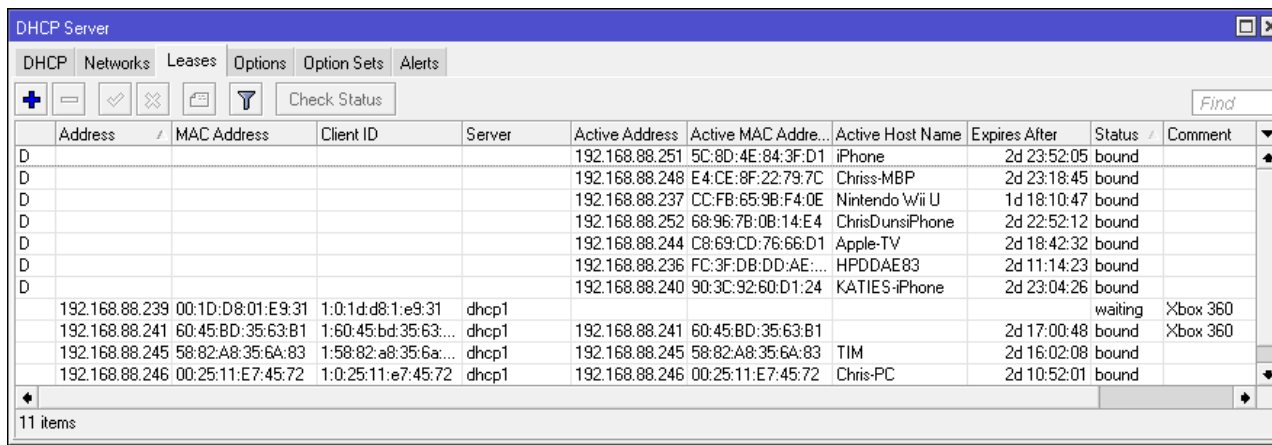
	Name	Type	L2 MTU	Tx	Rx
R	bridge1	Bridge	1598	7.2 Mbps	684.4 kbps
R	ether1	Ethernet	1598	756.5 kbps	6.4 Mbps
RS	ether2	Ethernet	1598	5.9 Mbps	0 bps
RS	ether3 - Xbox 360	Ethernet	1598	6.4 Mbps	488.3 kbps
S	ether4	Ethernet	1598	0 bps	0 bps
S	ether5	Ethernet	1598	0 bps	0 bps
RS	wlan1	Wireless (Atheros AR9...	1600	6.7 Mbps	204.8 kbps

- Specific device not working?

Reviewing those Service Calls

Service is not working

- Specific device not working?
 - Is it being assigned an IP address?



The screenshot shows the DHCP Server console window. The 'Leases' tab is selected. The table below displays the current DHCP leases. The status of the lease for IP 192.168.88.246 is 'waiting', which corresponds to the 'Service is not working' mentioned in the text.

Address	MAC Address	Client ID	Server	Active Address	Active MAC Address	Active Host Name	Expires After	Status	Comment	
D				192.168.88.251	5C:8D:4E:84:3F:D1	iPhone	2d 23:52:05	bound		
D				192.168.88.248	E4:CE:8F:22:79:7C	Chriss-MBP	2d 23:18:45	bound		
D				192.168.88.237	CC:FB:65:9B:F4:0E	Nintendo Wii U	1d 18:10:47	bound		
D				192.168.88.252	68:96:7B:0B:14:E4	ChrisDunsiPhone	2d 22:52:12	bound		
D				192.168.88.244	C8:69:CD:76:66:D1	Apple-TV	2d 18:42:32	bound		
D				192.168.88.236	FC:3F:DB:DD:AE:...	HPDDAE83	2d 11:14:23	bound		
D				192.168.88.240	90:3C:92:60:D1:24	KATIES-iPhone	2d 23:04:26	bound		
	192.168.88.239	00:1D:D8:01:E9:31	1:0:1d:d8:1:e9:31	dhcp1				waiting	Xbox 360	
	192.168.88.241	60:45:BD:35:63:B1	1:60:45:bd:35:63:...	dhcp1	192.168.88.241	60:45:BD:35:63:B1		2d 17:00:48	bound	Xbox 360
	192.168.88.245	58:82:A8:35:6A:83	1:58:82:a8:35:6a:...	dhcp1	192.168.88.245	58:82:A8:35:6A:83	TIM	2d 16:02:08	bound	
	192.168.88.246	00:25:11:E7:45:72	1:0:25:11:e7:45:72	dhcp1	192.168.88.246	00:25:11:E7:45:72	Chris-PC	2d 10:52:01	bound	

- Can you ping it?

Reviewing those Service Calls

Service is not working

- Wireless client?
 - Signal strength?

Wireless Tables

Interfaces Nstreme Dual Access List Registration Connect List Security Profiles Channels

[-] [Filter] [Reset] Find

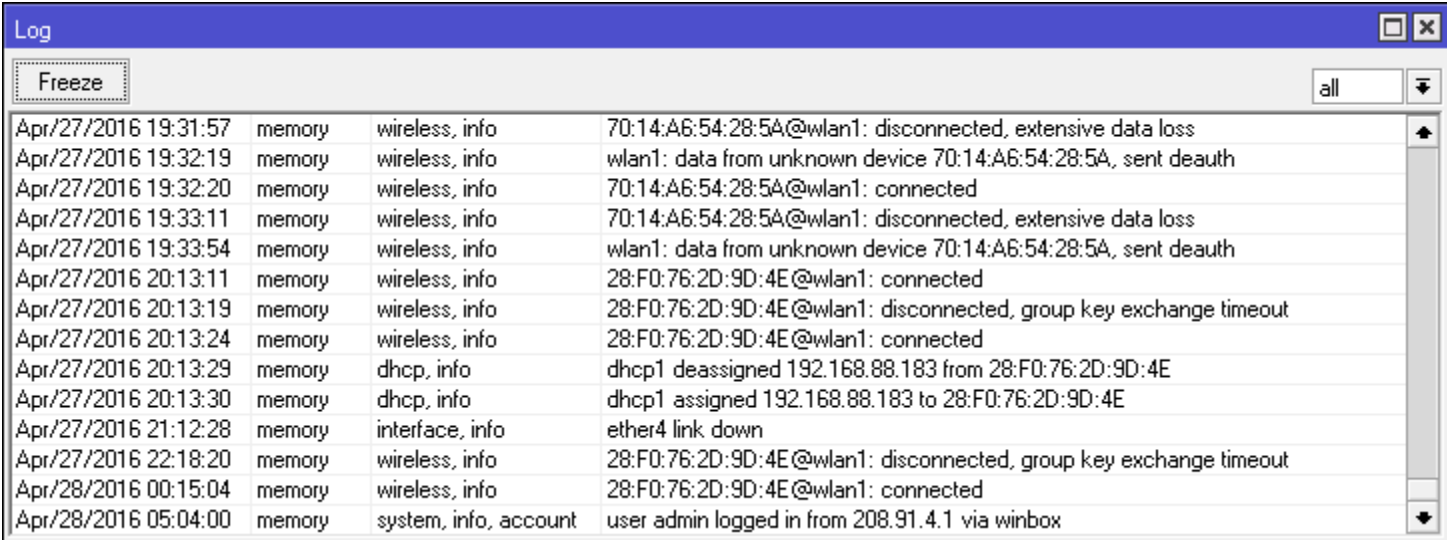
Radio Name	MAC Address	Interface	Uptime	AP	W...	Last Activit...	Tx/Rx Signal Strength (d...	Tx Rate	Rx Rate
	FC:3F:DB:DD:AE:84	wlan1	5d 04:23:41	no	no	1.270	-31	72.2Mbps-20MHz/1S/SGL	72.2Mbps-20MHz/1S
	5C:8D:4E:84:3F:D1	wlan1	00:10:29	no	no	1.170	-40	65Mbps-20MHz/1S/SGL	1Mbps
	CC:FB:65:9B:F4:0E	wlan1	2d 17:51:47	no	no	2.240	-40	65Mbps-20MHz/1S	1Mbps
	E4:CE:8F:22:79:7C	wlan1	00:43:51	no	no	1.060	-71	28.8Mbps-20MHz/2S/SGL	26Mbps-20MHz/1S
	C8:69:CD:76:66:D1	wlan1	5d 06:52:47	no	no	0.170	-74	39Mbps-20MHz/2S	26Mbps-20MHz/2S
	90:3C:92:60:D1:24	wlan1	00:58:08	no	no	0.670	-80	9Mbps	19.5Mbps-20MHz/1S

6 items

Reviewing those Service Calls

Service is not working

- Wireless client?
 - Check the log



The screenshot shows a window titled "Log" with a search filter set to "Freeze". The log contains the following entries:

Timestamp	Source	Category	Message
Apr/27/2016 19:31:57	memory	wireless, info	70:14:A6:54:28:5A@wlan1: disconnected, extensive data loss
Apr/27/2016 19:32:19	memory	wireless, info	wlan1: data from unknown device 70:14:A6:54:28:5A, sent deauth
Apr/27/2016 19:32:20	memory	wireless, info	70:14:A6:54:28:5A@wlan1: connected
Apr/27/2016 19:33:11	memory	wireless, info	70:14:A6:54:28:5A@wlan1: disconnected, extensive data loss
Apr/27/2016 19:33:54	memory	wireless, info	wlan1: data from unknown device 70:14:A6:54:28:5A, sent deauth
Apr/27/2016 20:13:11	memory	wireless, info	28:F0:76:2D:9D:4E@wlan1: connected
Apr/27/2016 20:13:19	memory	wireless, info	28:F0:76:2D:9D:4E@wlan1: disconnected, group key exchange timeout
Apr/27/2016 20:13:24	memory	wireless, info	28:F0:76:2D:9D:4E@wlan1: connected
Apr/27/2016 20:13:29	memory	dhcp, info	dhcp1 deassigned 192.168.88.183 from 28:F0:76:2D:9D:4E
Apr/27/2016 20:13:30	memory	dhcp, info	dhcp1 assigned 192.168.88.183 to 28:F0:76:2D:9D:4E
Apr/27/2016 21:12:28	memory	interface, info	ether4 link down
Apr/27/2016 22:18:20	memory	wireless, info	28:F0:76:2D:9D:4E@wlan1: disconnected, group key exchange timeout
Apr/28/2016 00:15:04	memory	wireless, info	28:F0:76:2D:9D:4E@wlan1: connected
Apr/28/2016 05:04:00	memory	system, info, account	user admin logged in from 208.91.4.1 via winbox

Reviewing those Service Calls

Service is slow

- ▶ Bandwidth utilization? (3:30am)

The screenshot displays three windows from a network management interface:

- Interface List:** A table showing bandwidth utilization for various interfaces. Red boxes highlight '6.1 Mbps' for ether1 and '6.0 Mbps' for wlan1. Red arrows point from these values to the traffic filter configuration.
- Torch (Running):** A traffic filter configuration window for interface 'ether1'. It shows source and destination addresses (0.0.0.0/0) and various protocol options. A red arrow points from the '6.0 Mbps' value in the Interface List to the 'Tx Rate' column in the Packet Sniffer table.
- Packet Sniffer Packets:** A table showing captured traffic. Red boxes highlight packets from 208.111.151.24 to 192.168.88.238 and from 184.25.254.56 to 192.168.88.238. Red arrows point from these packets to the 'Tx Rate' and 'Rx Rate' columns in the bottom table.

Name	Type	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)
bridge1	Bridge	1598	6.0 Mbps	151.7 kbps	502	362
ether1	Ethernet	1598	241.9 kbps	6.1 Mbps	328	515
ether2	Ethernet	1598	512 bps	0 bps	1	0
ether3	Ethernet	1598	0 bps	0 bps	0	0
ether4	Ethernet	1598	0 bps	0 bps	0	0
ether5	Ethernet	1598	0 bps	0 bps	0	0
wlan1	Wireless (Atheros AR9...	1600	6.0 Mbps	192.3 kbps	502	362

Et...	Prot...	Src	Dst	VLAN Id	DSCP	Tx Rate	Rx Rate
800	(ip)	208.111.151.24	192.168.100.10			76.1 kbps	3.1 Mbps
800	(ip)	184.25.254.56	192.168.100.10			79.5 kbps	2.8 Mbps
800	(ip)	208.111.151.24	192.168.100.10			65.4 kbps	2.9 kbps

Time...	Interface	Direction	Src. Address	Src. Port	Dst. Address	Dst. Port	Prot...
7.692	bridge1	rx	192.168.88.238	50188	208.111.151.24	80	204...
7.692	ether1	tx	192.168.100.10	50188	208.111.151.24	80	204...
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188	204...
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188	204...
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188	204...
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188	204...
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188	204...
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188	204...
7.697	ether1	rx	192.168.88.238	50188	208.111.151.24	80	204...
7.697	bridge1	tx	192.168.88.238	50188	208.111.151.24	80	204...
7.697	ether1	tx	192.168.100.10	50188	208.111.151.24	80	204...
7.700	ether1	rx	184.25.254.56	80	192.168.100.10	50229	204...
7.700	bridge1	tx	184.25.254.56	80	192.168.88.238	50229	204...
7.700	wlan1	tx	184.25.254.56	80	192.168.88.238	50229	204...
7.700	ether1	rx	184.25.254.56	80	192.168.100.10	50229	204...

Reviewing those Service Calls

Service is slow

- ▶ Bandwidth utilization?

Packet Sniffer Packets

Time...	Interface	Direction	Src. Address	Src. Port	Dst. Address	Dst. Port	Prot...	IP Pr...
7.692	bridge1	rx	192.168.88.238	50188	208.111.151.24	80	204...	6 (tcp)
7.692	ether1	tx	192.168.100.10	50188	208.111.151.24	80	204...	6 (tcp)
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188		
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188		
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188		
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188		
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188		
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188		
7.697	wlan1	rx	192.168.88.238	50188	208.111.151.24	80		
7.697	bridge1	rx	192.168.88.238	50188	208.111.151.24	80		
7.697	ether1	tx	192.168.100.10	50188	208.111.151.24	80		
7.700	ether1	rx	184.25.254.56	80	192.168.100.10	50188		
7.700	bridge1	tx	184.25.254.56	80	192.168.88.238	50188		
7.700	wlan1	tx	184.25.254.56	80	192.168.88.238	50188		

106 items (1 selected)

DHCP Server

Active Addr...	Active MAC Address	Active Host Name
D 192.168.88.208	F8:27:93:82:CB:7C	Jamess-iPhone
D 192.168.88.213	80:86:F2:1A:33:F8	Sully
D 192.168.88.218	80:E6:50:9B:09:AA	Jacys-iPhone
D 192.168.88.219	00:25:AE:85:E8:0A	
D 192.168.88.222	34:12:98:E3:E5:F3	iPhone
D 192.168.88.226	CC:78:5F:46:20:2A	Nicks-iPhone
D 192.168.88.230	04:E5:36:65:D7:CD	Jacys-iPad
D 192.168.88.233	00:17:F2:4A:A0:00	
D 192.168.88.236	04:DB:56:26:F0:33	Jakes-iPhone
D 192.168.88.238	C0:33:5E:9D:98:68	XboxOne
D 192.168.88.241	C8:BC:C8:C8:06:D6	
D 192.168.88.242	B8:78:2E:3A:5D:4E	Apple-TV
D 192.168.88.243	D0:9D:AB:43:DE:67	android-80b39c2c6f40a72c
D 192.168.88.245	00:22:AA:1D:D7:0C	Wii
D 192.168.88.247	54:E4:3A:BD:DE:6F	Jamess-iPad
D 192.168.88.248	68:85:99:3E:B2:FC	HP3EB2FC
D 192.168.88.251	90:48:9A:91:AC:43	CodyPC
D 192.168.88.254	10:9A:DD:5A:08:CC	

18 items (1 selected)

Reviewing those Service Calls

Service is slow

- ▶ Bandwidth utilization?

WHOIS IP Lookup Tool

The IPWHOIS Lookup tool finds contact information for the owner of a specified

Enter a host name or an IP address:

Related Tools: [DNS Traversal](#) [Traceroute](#) [Vector Trace](#) [Ping](#) [WHOIS Lookup](#)

Source: whois.arin.net
IP Address: 208.111.151.24 (United States)
Name: LLNW-3
Handle: NET-208-111-128-0-1
Registration Date: 3/30/06
Range: 208.111.128.0-208.111.191.255
Org: Limelight Networks, Inc.
Org Handle: LLNW
Address: 222 South Mill Ave.
Suite 800
City: Tempe
State/Province: AZ
Postal Code: 85281
Country: UNITED STATES
Name Servers:

Time...	Interface	Direction	Src. Address	Src. Port	Dst. Address	Dst. Port
7.692	bridge1	rx	192.168.88.238	50188	208.111.151.24	80
7.692	ether1	tx	192.168.100.10	50188	208.111.151.24	80
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188
7.695	ether1	rx	208.111.151.24	80	192.168.100.10	50188
7.695	bridge1	tx	208.111.151.24	80	192.168.88.238	50188
7.695	wlan1	tx	208.111.151.24	80	192.168.88.238	50188
7.697	wlan1	rx	192.168.88.238	50188	208.111.151.24	80
7.697	bridge1	rx	192.168.88.238	50188	208.111.151.24	80
7.697	ether1	tx	192.168.100.10	50188	208.111.151.24	80
7.700	ether1	rx	184.25.254.56	80	192.168.100.10	50188
7.700	bridge1	tx	184.25.254.56	80	192.168.88.238	50188
7.700	wlan1	tx	184.25.254.56	80	192.168.88.238	50188

IP	MAC	Company
192.168.88.218	80:E6:50:9B:09:AA	Jacys-iPhone
192.168.88.219	00:25:AE:85:E8:0A	
192.168.88.222	34:12:98:E3:E5:F3	iPhone
192.168.88.226	CC:78:5F:46:20:2A	Nicks-iPhone
192.168.88.230	04:E5:36:65:D7:CD	Jacys-iPad
192.168.88.233	00:17:F2:4A:A0:00	
192.168.88.236	04:DB:56:26:F0:33	Jakes-iPhone
192.168.88.238	C0:33:5E:9D:98:68	XboxOne
192.168.88.241	C8:BC:C8:C8:06:D6	
192.168.88.242	B8:78:2E:3A:5D:4E	Apple-TV
192.168.88.243	D0:9D:AB:43:DE:67	android-80b39c2c6f40a72c
192.168.88.245	00:22:AA:1D:D7:0C	Wii
192.168.88.247	54:E4:3A:BD:DE:6F	Jamess-iPad
192.168.88.248	68:85:99:3E:B2:FC	HP3EB2FC
192.168.88.251	90:48:9A:91:AC:43	CodysPC
192.168.88.254	10:9A:DD:5A:08:CC	

Bandwidth Utilization

- ▶ What bandwidth is the subscriber's service
 - Download/Upload
 - 3/.768, 6/1.5, 12/3, ... Mbps
- ▶ Is it being fully utilized
 - By who?
 - Download/Upload?
- ▶ **Solutions**
 - Upgrade subscribers service speed
 - Additional revenue
 - Limit bandwidth to a device (TV – video streaming)
 - Assign static IP
 - Implement queues

Reviewing those Service Calls

Service is slow

- ▶ Service is slow – Wireless connected client?

The image shows two overlapping windows from a network management application. The top window is titled 'Interface <wlan1>' and has tabs for 'General', 'Wireless', 'HT', 'HT MCS', 'WDS', 'Nstreme', 'Status', and 'Traffic'. The 'Wireless' tab is active, showing configuration for 'Mode: ap bridge', 'Band: 2GHz-B/G/N', 'Channel Width: 20MHz', and 'Frequency: 2462' (highlighted with a red box). The bottom window is titled 'Scanner (Running)' and shows the 'Interface: wlan1' selected. It contains a table of detected wireless networks.

	Address	SSID	Channel	Signal ...	Noise...	Signal To Noise	
AP	FC:3F:DB:DD:AE:85	DIRECT-84-HP Officejet 5740	2462/20/gn	-24	-102	78	
AP	28:C6:8E:2D:36:E4	HENIGAN	2412/20/g	-73	-98	25	
AP	00:26:F2:C8:B7:68	LawrenceNet	2412/20/g	-94	-98	4	
De A	16:81:00:DA:AF:A8	BroadbandHamnet-v1	2412/20/g	-93	-98	5	
PRB	00:80:48:68:85:1C	afescr24	2417/20/g	-95	-113	18 008	

Reviewing those Service Calls

Service is slow

- ▶ Service is slow – Wireless connected client?

The screenshot shows the configuration window for interface <wlan1>. The 'Wireless' tab is active, and the 'Frequency' is set to 2462 MHz. An overlay window titled 'Freq. Usage (Running)' displays a table of frequency usage for the interface 'wlan1'.

Frequency (MHz)	Usage	Noise F...
2412	0.0	-97
2417	0.0	-100
2422	0.0	-104
2427	0.0	-117
2432	0.0	-101
2437	1.3	-99
2442	0.0	-108
2447	12.1	-109
2452	2.9	-100
2457	0.0	-101
2462	0.6	-103

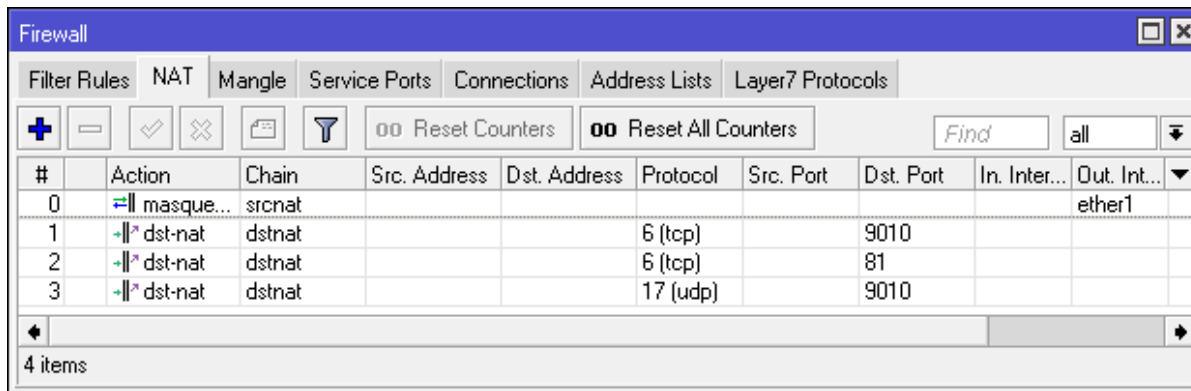
Reviewing those Service Calls

Service is slow

- ▶ Service is slow
 - Wireless Interference
 - Signal strength?
 - Interference?
 - Wireless printer
 - Satellite TV service
 - Home router
 - Tethered device

Reviewing those Service Calls

- ▶ Unable to access camera from Internet
 - Connected? IP address?
 - Configure port forwarding



The screenshot shows the Mikrotik WinBox Firewall Filter Rules configuration window. The 'Filter Rules' tab is selected. The table below shows the configured rules:

#	Action	Chain	Src. Address	Dst. Address	Protocol	Src. Port	Dst. Port	In. Inter...	Out. Int...
0	masque...	srcnat							ether1
1	dst-nat	dstnat			6 (tcp)		9010		
2	dst-nat	dstnat			6 (tcp)		81		
3	dst-nat	dstnat			17 (udp)		9010		

4 items

- ▶ No service in a section of home
 - Additional router/s
 - Large complex homes can required 4 to 5 wireless Aps
 - Additional router configured as a repeater forming a mesh network when cabling is an issue

Managed Router

- ▶ Remember you have full control over the router
 - Enable/Disable interfaces
 - Extensive diagnostics
 - Bandwidth test
 - Ping
 - Torch
 - Packet sniffer
 - Trace route
 - Graphing
- ▶ If subscriber wants to use his own router, offer a managed service – turn of the wireless interface
 - Turn it on when necessary to do diagnostics

Home Networking Tips

- ▶ Focus on your goals, optimize your resources
 - Do it right first time, do not cut corners
 - Document your network
 - Focus on your strengths
 - Standardize on equipment
 - Get your staff trained
 - Use consultants when necessary
- ▶ Increase your revenue
 - Reduce truck roll, focus on remote support
 - Additional revenue from router sales and support
 - Reduce the number of support staff required

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