



# Delivering Managed Services with MikroTik Products

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# Brian Horn

- BSEE, MIEEE
  - Computer Systems & Network Engineering
    - Since early 1980's when Ethernet was 10Base5
  - MikroTik Certified Trainer
- Founded Winters Broadband in 2002
  - WISP in rural CA
- Founded WISP TRACON in 2014
  - MikroTik Training and Consulting



# Service Provisioning

- What is demarcation point?
  - CPE or router?
  - Bridge or router mode?
  - Who has access to device?
- How do you handle customer service issues?
  - No service
  - Slow service
  - Intermittent service
- Tell customer issue is with his home network
  - Unhappy customer
  - Likely to consider alternative options

# Why Provide Managed Services?

- Analysis of technical support calls in 2011
  - Over 90% of calls were related to issues in customer home network
  - Customers had little or no understanding of networking
  - Customers expected us to provide support for their home networks
  - Technical support was costly and time consuming

Our business was being a WISP

We had no plan to be in the Technical Support business

# Managed Service Decision

- Selecting the devices to use – MikroTik
  - Consistent User Interface across all devices
    - Minimizes training and support costs
  - Range of devices to suit business or customer application
    - NOC, tower site, business or residential customer
  - Software upgrades and support
  - Cost effective pricing
    - No support contracts or software upgrade costs
- Managed Service offerings introduced in 2011
  - Over 1,000 managed services now implemented

# Managed Devices

- hAP ac lite
- hAP ac
- wAP
- RB2011
- RB3011
- hEX PoE

Other MikroTik products may be installed to create custom network

# Managed Service Implementation

- Initially an Installation Option
  - Annual service fee of \$30
  - CPE and Router are property of customer, covered by install charge
    - Avoid property taxes on low cost items which would have to be depreciated
    - Customer retention
- 2015 – Included in Installation Package
  - New service plans, price increased by \$2.50/month
  - Routers used to power CPE, eliminated PoE injector
  - Disable Wi-Fi if customer wants to use their own Wi-Fi device
  - IPv6 enabled
- Custom networks for business and large customer configurations

# 2018 - Internet of Things - IoT

- Typical home is Wi-Fi enabled
  - Up to 5 Wi-Fi access points/repeaters
    - Customers expect devices to be plug and play
    - No concept of frequency assignment or interference
    - Higher powered devices are better!
    - Higher priced devices must be better!
    - No concept of firewalls, bandwidth utilization or traffic prioritization
  - 20 to 40 wireless attached devices
  - Some homes no longer have a device with an Ethernet port



# Benefits of Managed Services

- Customer Satisfaction
  - Prompt resolution of customer issues
    - No service
    - Slow Service
    - Intermittent Service
    - Service irregularities
  - Managed Troubleshooting
    - Customer does not need to plug PC directly into PoE – If available
    - Known router configuration
    - Extensive diagnostics
  - Chargeable service calls still offered – time and materials
    - No charge if issue is not customer related

# Benefits of Managed Services

- Increased ROI
  - Increased Revenue
    - Sales and recurring revenue
  - Reduced Technical Support Costs
    - Reduced number of staff
    - Reduced number of truck rolls
- Technology Upgrade Path
  - Bug fixes
  - Product enhancements
  - IPv6 deployment

# Configuration and Diagnostics

Please watch presentation video to get full details

# Tools – Configuration Options

- Firewall
  - Protection and port forwarding
- Queues
  - Bandwidth control
- Graphing
  - History of usage
- Wireless Access Lists
  - Controlled access with options
- Wireless SSID
  - Know which devices you control (WB-A###)

Export and save configuration to remote site

# Tools - Diagnostics

- Interface -> Statistics & Status
- Wireless -> Registration
- Wireless -> Scan
- IP -> ARP
- IP -> DHCP Server
- IP -> Neighbors
- Log
- VPN
- Tools
  - Bandwidth test
  - IP Scan
  - Packet sniffer
  - Ping
  - Telnet
  - Torch
  - Traceroute
- New Terminal -> Export

# Diagnostics

## Interface Statistics

Overall Stats	Rx Stats	Tx Stats	Status	Traffic	...
Rx Broadcast:	29477				
Rx Pause:	0				
Rx Multicast:	391862				
Rx FCS Error:	8194				
Rx Align Error:	0				
Rx Too Short:	0				
Rx Overflow:	0				
Rx Length Error:	0				
Rx Code Error:	8185				
Rx Jabber:	0				

## Interface Status

Overall Stats	Rx Stats	Tx Stats	Status	Traffic	...
Last Link Down Time:					
Last Link Up Time:	Apr/02/2018 05:10:28				
Link Downs:	0				
Auto Negotiation:	done				
Rate:	1Gbps				
	<input checked="" type="checkbox"/> Full Duplex				
Advertising:	10M full				
	100M full				
	1000M full				
Link Partner Advertising:	10M half				
	10M full				
	100M half				
	100M full				
	1000M full				

# Diagnostics

## Wireless Registration

MAC Address	Interface	Uptime	AP	WDS	Last Activity (s)	Tx/Rx Signal Strength (dBm)	Tx Rate	Rx Rate
A4:EE:57:3E:7C:09	wlan1 - 2G	26d 07:55:37	no	no	2.570	-72	26Mbps-20MHz/1S	52Mbps-20MHz/1S
28:CF:DA:B1:78:41	wlan1 - 2G	5d 05:42:49	no	no	3.570	-47	144.4Mbps-20MHz/2S/SGL	130Mbps-20MHz/2S
64:76:BA:A5:3F:88	wlan1 - 2G	2d 21:28:09	no	no	0.440	-73	86.6Mbps-20MHz/2S/SGL	72.2Mbps-20MHz/1S/SGL
C4:1C:FF:30:C8:E6	wlan1 - 2G	13:19:46	no	no	0.720	-71	104Mbps-20MHz/2S	78Mbps-20MHz/2S
90:B9:31:DF:0B:92	wlan2 - 5G	11:33:45	no	no	3.530	-63	72.2Mbps-20MHz/1S/SGL	65Mbps-20MHz/1S
C0:B6:58:C0:55:51	wlan2 - 5G	00:15:43	no	no	0.000	-68	65Mbps-20MHz/1S/SGL	78Mbps-20MHz/1S
78:7E:61:E7:B6:DF	wlan2 - 5G	00:04:17	no	no	0.000	-63	57.7Mbps-20MHz/1S/SGL	58.5Mbps-20MHz/1S
40:4E:36:90:30:7F	wlan1 - 2G	00:03:45	no	no	4.810	-87	1Mbps	26Mbps-20MHz/2S

## Wireless Scan

	Address	SSID	Channel	Signal Strength	Noise Floor	Signal To Noise
AP	70:3A:CB:6C:0B:AF	NiemelaHome	5745/20-Ceee/ac(28dBm)	-88	0	0
APRW	DC:9F:DB:3C:35:8D	WintersBroadbandNDM	5825/20/an(28dBm)	-85	0	0
AP	62:45:B1:27:96:2C		5200/20/a(28dBm)	-82	0	0
P	72:3A:CB:6C:0B:AD		5745/20-Ceee/ac(28dBm)	-87	0	0

# Diagnostics

## IP -> ARP

ARP List

	IP Address	MAC Address	Interface
DC	208.91.7.83	DC:9F:DB:78:33:00	Network
DC	208.91.7.84	DC:9F:DB:78:33:00	Network
DC	208.91.7.85	DC:9F:DB:78:33:00	Network

## IP - > Neighbors

Neighbor List

Discovery Settings

Interface	IP Address	MAC Address	Identity	Platform	Version
ether3 - ...	208.91.7.37	D4:CA:6D:FB:C0:A0	Bob Bums	MikroTik	6.41 (stable)
ether3 - ...	208.91.7.150	E4:8D:8C:C4:CE:02	Knapp, Brian	MikroTik	6.41.3 (stable)
ether3 - ...	208.91.7.40	00:0C:42:E2:11:4F	Unkel Williams	MikroTik	6.41.3 (stable)
ether3 - ...	208.91.7.83	D4:CA:6D:B4:7C:4E	Martinez, Chris	MikroTik	6.41.3 (stable)
ether3 - ...	208.91.7.67	D4:CA:6D:E0:57:F8	Schin-Lee	MikroTik	6.40.4 (stable)
ether3 - ...	208.91.7.88	64:D1:54:BA:3D:CE	Hay, Nancy	MikroTik	6.40.4 (stable)



# Diagnostics

## Torch

Eth. Protocol	Protocol	Src.	Dst.	VLAN Id	DSCP	Tx Rate	Rx Rate	Tx Packet Rate	Rx Packet Rate
800 (ip)		93.184.215.240	192.168.100.9			125.0 kbps	6.0 Mbps	256	537
800 (ip)		208.91.4.15	192.168.100.10			76.8 kbps	4.9 kbps	8	8
800 (ip)		23.72.183.183	192.168.100.9			4.3 kbps	4.3 kbps	9	9
800 (ip)		208.91.4.4	192.168.100.9			2.1 kbps	3.0 kbps	2	2
800 (ip)		50.112.21.105	192.168.100.9			10.3 kbps	2.8 kbps	2	1
800 (ip)		208.91.4.5	192.168.100.9			640 bps	1768 bps	1	1
800 (ip)		157.56.144.215	192.168.100.9			824 bps	1208 bps	1	1
800 (ip)		54.87.198.82	192.168.100.9			0 bps	0 bps	0	0
800 (ip)		185.158.113.167	192.168.100.9			0 bps	0 bps	0	0
800 (ip)		50.22.136.101	192.168.100.9			0 bps	0 bps	0	0
800 (ip)		54.225.247.189	192.168.100.9			0 bps	0 bps	0	0
800 (ip)		40.97.128.226	192.168.100.9			0 bps	0 bps	0	0
800 (ip)		216.58.194.170	192.168.100.9			0 bps	0 bps	0	0

You can look up destination with “Who Is”

- <https://www.networksolutions.com/whois/index.jsp>

# Diagnostics

## DHCP Server

	Address	MAC Address	Server	Active Host Name	Expires After	Status
D	192.168.88.239	14:B7:F8:7C:77:F6	dhcp1		15:26:22	bound
D	192.168.88.240	14:B7:F8:7C:81:7B	dhcp1		22:00:57	bound
D	192.168.88.241	14:B7:F8:AF:B9:EA	dhcp1	DIRECTV-HS17-F8AFB9E9	13:39:18	bound
D	192.168.88.242	14:B7:F8:7C:80:6D	dhcp1		14:54:37	bound
D	192.168.88.244	D0:03:4B:0C:6A:17	dhcp1	Bedroom	15:48:40	bound
D	192.168.88.246	60:03:08:D2:80:80	dhcp1	LivingRmAppleTV	22:00:09	bound
D	192.168.88.247	00:56:CD:29:5E:DD	dhcp1	Jane	21:47:16	bound
D	192.168.88.248	C8:BC:C8:C6:34:8D	dhcp1	PHILLIPOXsiMac6	23:11:20	bound
D	192.168.88.249	88:53:95:CA:8F:6E	dhcp1	Phil-2	23:12:05	bound
D	192.168.88.250	B8:E8:56:6A:BA:36	dhcp1	PHILLIPs-iPad	19:02:36	bound
D	192.168.88.251	D0:4F:7E:3E:21:3C	dhcp1	iPad-5	22:17:58	bound

## MAC Address lookup allows you to determine device manufacturer

- <https://aruljohn.com/mac.pl>

# Diagnostics

## Log

Log			
Freeze			
Apr/12/2018 15:08:27	memory	wireless, info	00:56:CD:29:5E:DD@wlan1 - 2G: disconnected, received disassoc: sending station leaving (8)
Apr/12/2018 15:08:44	memory	wireless, info	D0:4F:7E:3E:21:3C@wlan2 - 5G: disconnected, extensive data loss
Apr/12/2018 15:08:54	memory	wireless, info	D0:4F:7E:3E:21:3C@wlan2 - 5G: connected
Apr/12/2018 15:09:18	memory	wireless, info	00:56:CD:29:5E:DD@wlan1 - 2G: connected
Apr/12/2018 15:13:00	memory	wireless, info	88:53:95:CA:8F:6E@wlan1 - 2G: connected
Apr/12/2018 15:13:06	memory	wireless, info	88:53:95:CA:8F:6E@wlan1 - 2G: disconnected, received disassoc: sending station leaving (8)
Apr/12/2018 15:29:14	memory	wireless, info	C8:BC:C8:C6:34:8D@wlan1 - 2G: disconnected, group key exchange timeout
Apr/12/2018 15:34:36	memory	wireless, info	C8:BC:C8:C6:34:8D@wlan1 - 2G: connected
Apr/12/2018 15:39:14	memory	wireless, info	C8:BC:C8:C6:34:8D@wlan1 - 2G: disconnected, group key exchange timeout
Apr/12/2018 15:39:54	memory	wireless, info	D0:4F:7E:3E:21:3C@wlan2 - 5G: disconnected, extensive data loss
Apr/12/2018 15:40:01	memory	wireless, info	D0:4F:7E:3E:21:3C@wlan2 - 5G: connected

Log			
Freeze			
Apr/12/2018 08:24:46	memory	interface, warning	sfp1-ATT fcs error on link
Apr/12/2018 08:52:16	memory	interface, warning	sfp1-ATT fcs error on link
Apr/12/2018 08:59:16	memory	interface, warning	sfp1-ATT fcs error on link

# Tools

## IP Scan

Address	MAC Address	Time (ms)
192.168.88.1		0
192.168.88.170	40:4E:36:90:30:7F	188
192.168.88.171	C0:B6:58:C0:55:51	3
192.168.88.182	28:CF:DA:B1:78:41	32
192.168.88.185	64:76:BA:A5:3F:88	90
192.168.88.203	A4:EE:57:3E:7C:09	81
192.168.88.204	C0:33:5E:F4:71:35	2
192.168.88.205	C4:1C:FF:30:C8:E6	1

## Bandwidth Test

The screenshot shows a 'Bandwidth Test' application window with the following configuration and results:

- Test To: 10.0.60.140
- Protocol:  udp  tcp
- Local UDP Tx Size: 1500
- Remote UDP Tx Size: 1500
- Direction: receive
- TCP Connection Count: 20
- Local Tx Speed: [ ] bps
- Remote Tx Speed: [ ] bps
- Random Data
- User: admin
- Password: [ ]
- Lost Packets: 0
- Tx/Rx Current: 0 bps/26.8 Mbps
- Tx/Rx 10s Average: 0 bps/25.7 Mbps
- Tx/Rx Total Average: 0 bps/24.5 Mbps

A graph at the bottom shows Tx (blue) and Rx (red) activity. The Rx activity is visible, with a legend indicating Rx: 28.3 Mbps. The status bar at the bottom left says 'stopped'.

# Case Studies Customer Tickets

**Please watch presentation video to get full details**

# Advanced Customer Configurations

- Firewall
  - Protect customer network, allow management access
- Port forwarding
  - Security systems
- Bandwidth Utilization
  - Limit streaming devices
- Wireless Connectivity
  - Specific devices, time of day
- Traffic Prioritization
  - VoIP devices

# No Service

- All devices or one specific?
  - All devices
    - Device powered down
    - Cables changed or unplugged
  - Specific device
    - Connected to router?
    - IP address allocated?
- Port forwarding

# Slow Service

- Bandwidth Utilization
  - Streaming devices
  - Download vs Upload
- Network association
- Interference
  - CPE
  - Home wireless network



# Intermittent Service

- Wireless association
  - 2G vs 5G
- Signal strength
  - Location

# Service Irregularities

- VPN into Customer Router
  - PPTP, L2TP
- Get same experience as customer

