



# Large Scale MPLS/VPLS WiFi Deployment

Robert "Pat" Harris, March 2013

# Introduction

- Robert “Pat” Harris
- Network Analyst for United States Sugar Corp.
- About U. S. Sugar Corp.

# United States Sugar Corporation



3/16/2013

# United States Sugar Corporation

- Headquartered in Clewiston, Florida, the Company farms over 180,000 acres and operates a state-of-the-art citrus nursery on 80 acres in Northern Florida.
- U.S. Sugar is the USA's largest vertically integrated producer of sugarcane and refined cane sugar.
- Our subsidiary, Southern Gardens Citrus, is one of Florida's major growers of oranges and processors of orange juice products.
- In season, we process up to 42,000 tons of sugarcane per day and produce ~750,000 tons of refined sugar per year.
- With state-of-the-art technology for both sugar manufacturing and citrus processing, we practice the most efficient and progressive farming techniques in the world.
- We also own an independent short line railroad, the South Central Florida Express.
- We employ approx. 1700 employees, both full-time and seasonal.



# Operational Excellence

- To further build upon our competitive advantages of vertical integration, the best people, the best land, the largest farms, the newest sugar mill in the country and our railroad transportation advantage; U.S. Sugar's agriculture department identified a new initiative which has been called Operational Excellence (OPx).
- OPx is the ability to perform the right operation, at the right time, at the right quality level.
- The expected results of this five-year, multi-million dollar project are increased sugar cane production with reduced costs.
- The scope of OPx is large and includes land preparation, planting, chemical and mechanical cultivation, crop nutrition, harvesting, and water control.
- Opx involves significant automation and technology investment for our agricultural equipment.

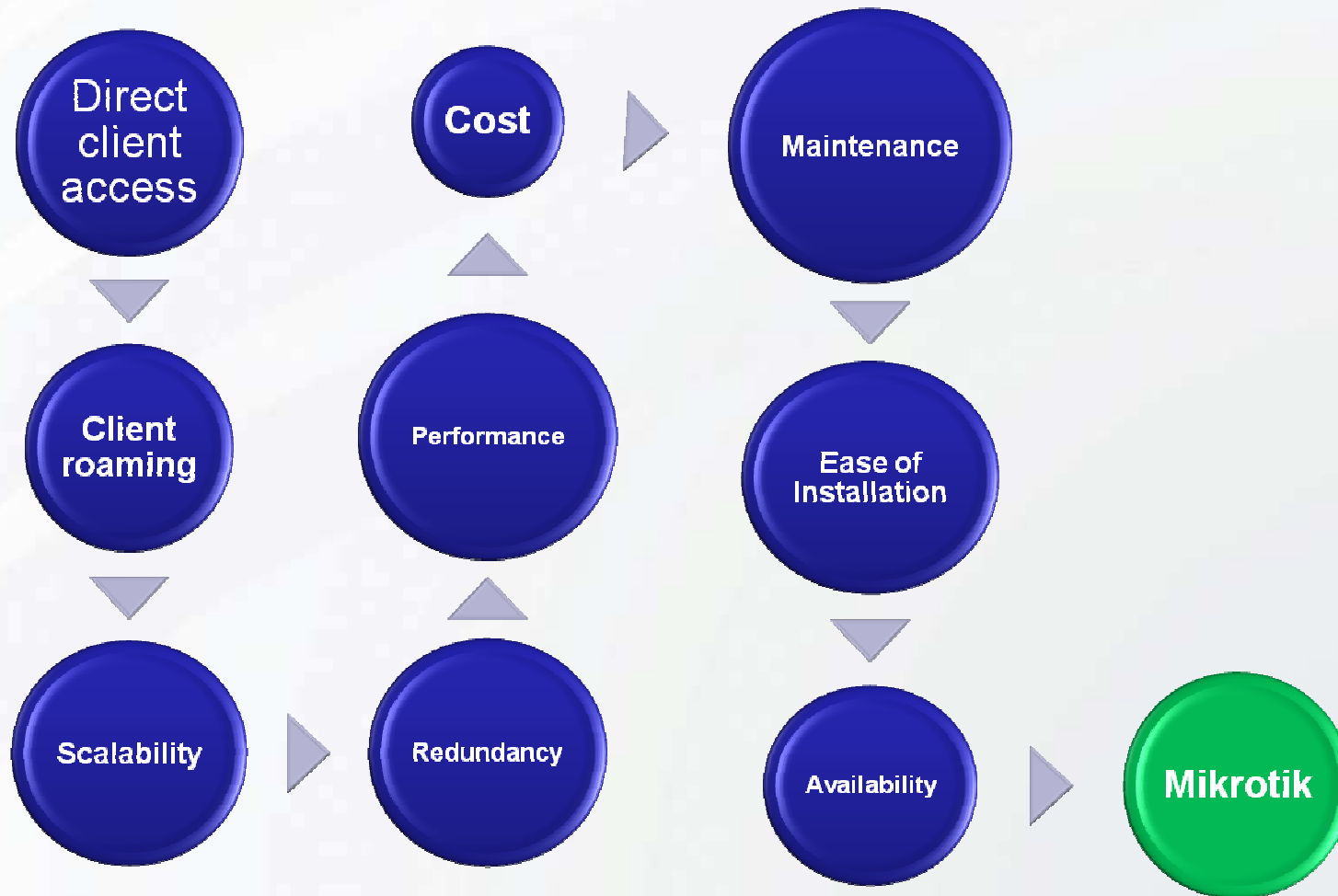
# Operational Excellence

- There are several milestones on the way to the ultimate goal of OPx which require a connected infrastructure:
  - Leverage GPS/GIS functionality for map view, location information, precision agriculture and data analysis for all vehicles (tractors, harvesters, trucks etc.).
  - Retrieve vehicle data such as equipment hours, equipment performance characteristics (speed, temperature, failure codes, fuel burn, etc.) in real time.
  - Wireless communication for all fleet equipment and power units. Including weather stations and security systems.

# Operational Excellence

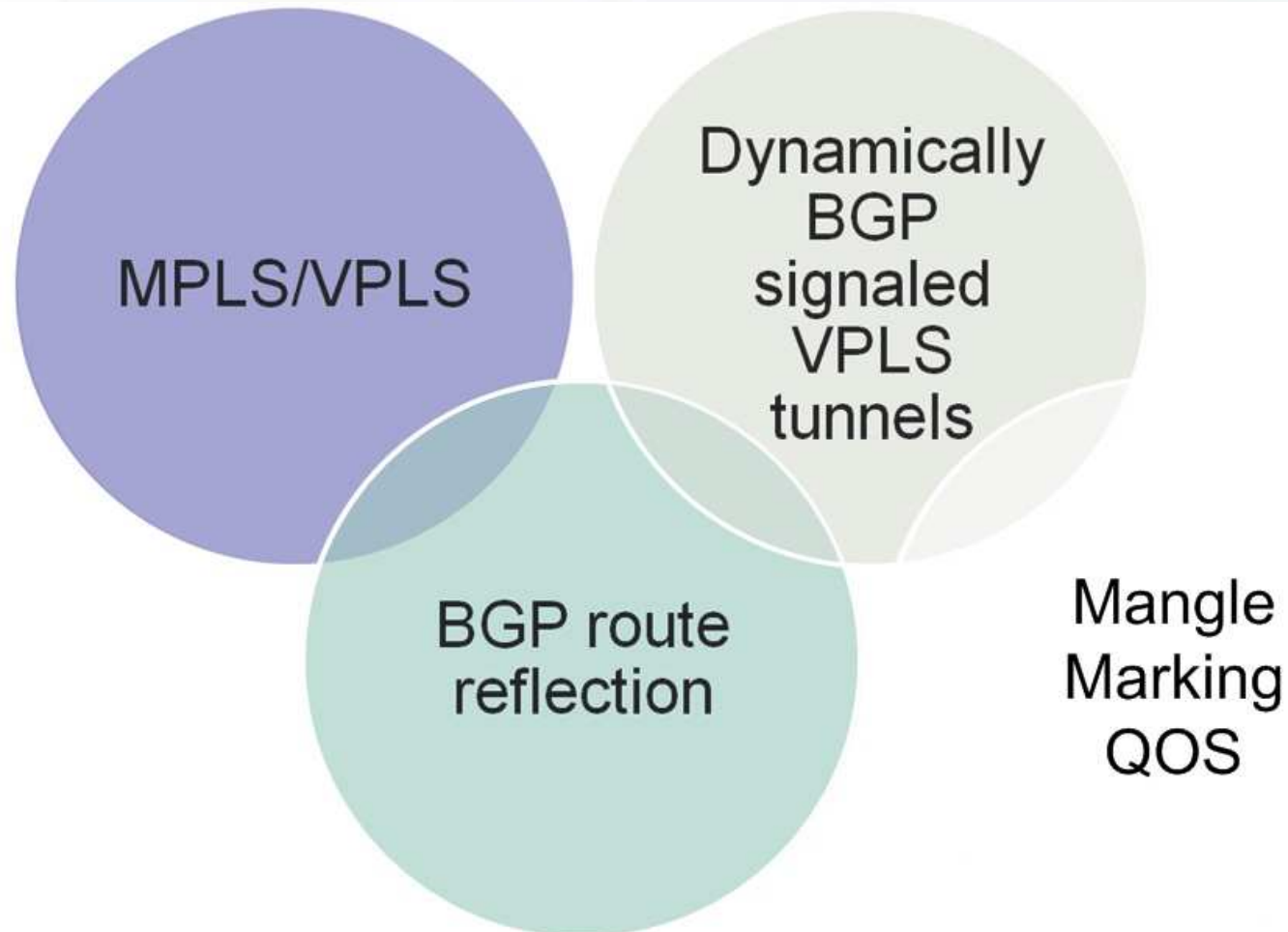
- Due to the size of our land holdings and the real-time, data intense requirements of Opx, an innovative solution was required.
- Cellular connectivity was ruled out due to cost availability and reliability.
- A private wireless WAN built on the 802.11 WiFi standard designed utilizing MPLS/VPLS creating a meshed topology was conceived.
- A combination of 120 foot towers, 50 foot towers, leased towers and sites on suitable tall structures within our plant facilities were used.
- In remote areas, solar energy is used to power the networking equipment.

# Design Considerations





# System Features



# Tips for Building an MPLS/VPLS System

IP connectivity  
for devices.

Can device see its  
neighbors

Review and select hardware with consideration to interface MTU capability should support a minimum 1526 byte MTU.

Configure your building  
blocks. Loopback, bridge.

Address your interfaces,  
L0, Bridge, Physical.

Add required interfaces/ports  
to your BridgeX interface.

Configure additional local services as  
required/desired, snmp, snmp, dhcp as example.

# Tips for Building an MPLS/VPLS System

Establish L3 connectivity RIP, OSPF, BGP, static

Construct your MPLS cloud, all interfaces forwarding traffic up to PE should be included (meshed). Decisions here for static or dynamic may be based upon scale, now and in the future.

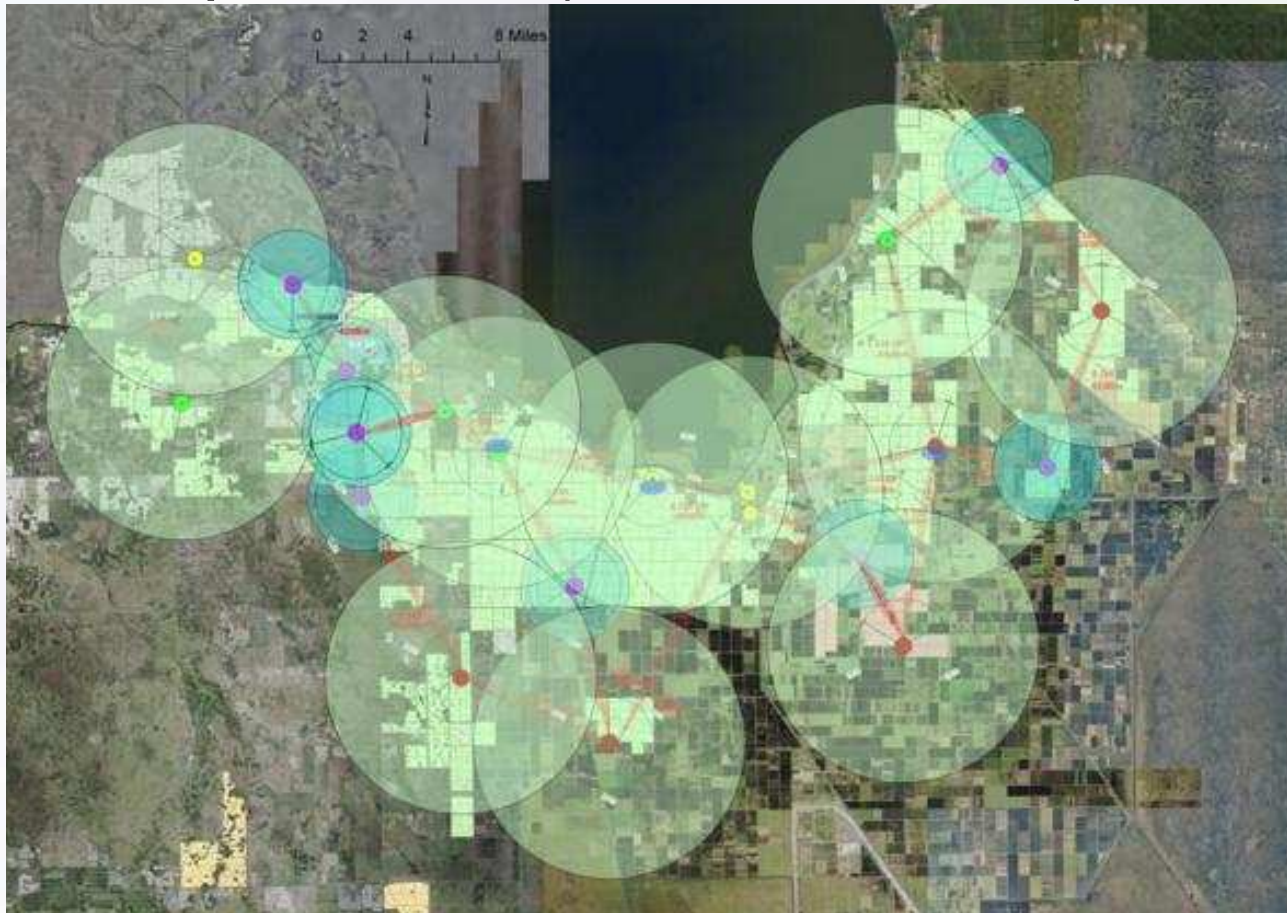
Connect your client interfaces with VPLS again decisions here for static or dynamic considering scale, now and in the future.

If dynamic path is chosen then BGP should be configured to provide signal path for VPLS tunnels.

Now enhance your network with QOS, TE, Monitoring and alerting, scripting to automate some functions (backups, react to various conditions, ect.)

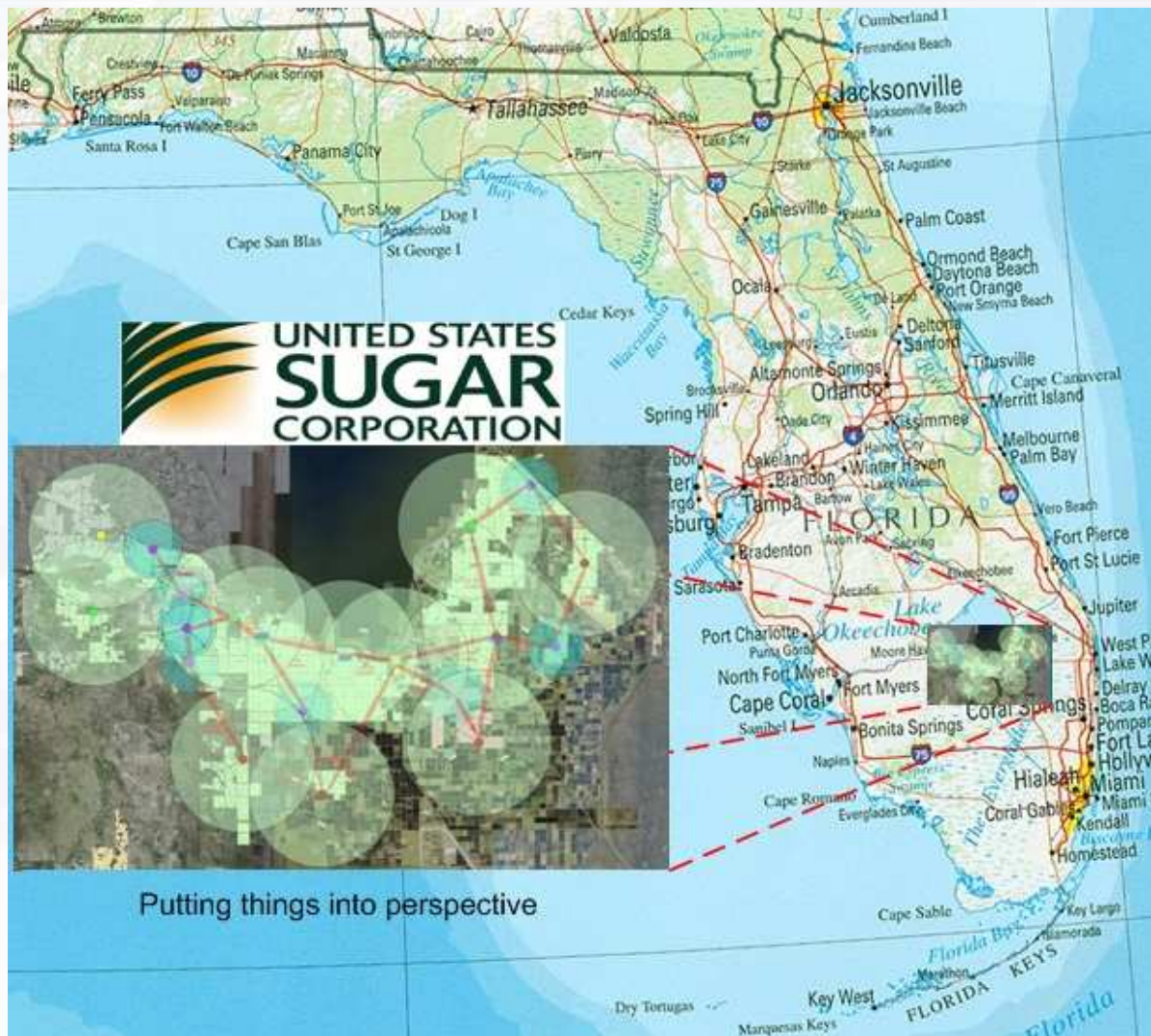
# Our System

A 300 square mile (77,600 hectare) network.





# Our System



Quite a large chunk of Florida.



# Our System



3/16/2013

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UNITED STATES  
**SUGAR**  
CORPORATION

**SOUTHERN  
GARDENS**  
CITRUS

# System Performance

- The system packet transmission times are very short!
- Label switch path is displayed on each trace, color annotation highlights the origin and target of each trace.



```
Terminal (Disconnected)
FIW
[admin@USSCREP-450G] > tool traceroute 10. .121
# ADDRESS RT1 RT2 RT3 STATUS
1 172. .2 1ms 1ms 1ms
2 172. .22 2ms 3ms 3ms <MPLS:L=6538,E=0>
3 172. .38 2ms 2ms 2ms <MPLS:L=3645,E=0>
4 172. .50 2ms 2ms 5ms <MPLS:L=85,E=0>
5 172. .66 4ms 2ms 2ms <MPLS:L=2400,E=0>
6 172. .70 4ms 3ms 2ms <MPLS:L=16447,E=0>
7 10. .121 5ms 2ms 2ms

[admin@USSCREP-450G] > tool traceroute 10. .114
# ADDRESS RT1 RT2 RT3 STATUS
1 172. .2 1ms 1ms 1ms
2 172. .22 3ms 2ms 2ms <MPLS:L=6541,E=0>
3 172. .38 3ms 3ms 5ms <MPLS:L=3642,E=0>
4 172. .50 3ms 3ms 3ms <MPLS:L=108,E=0>
5 172. .66 3ms 3ms 3ms <MPLS:L=1280,E=0>
6 172. .70 3ms 3ms 4ms <MPLS:L=16367,E=0>
7 172. .157 5ms 3ms 3ms <MPLS:L=1377,E=0>
8 10. .114 8ms 2ms 3ms

[admin@USSCREP-450G] > quit
interrupted
```

# System Performance

```
Main6509MSFC-A#ping 172. .24 ← Note: 1
Type escape sequence to abort.
Sending S, 100-byte ICMP Echos to 172. .24, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/8/16 ms
Main6509MSFC-A#trace
Main6509MSFC-A#traceroute 172. .24 ← Note: 2
Type escape sequence to abort.
Tracing the route to 172. .24
 0 10. 250 0 msec 0 msec 0 msec
 1 172. .2 0 msec 0 msec 0 msec
 2 172. .24 36 msec 8 msec 8 msec ← Note: 3
Main6509MSFC-A#ping
Protocol [ip]:
Target IP address: 172. .24
Repeat count [5]:
Datagram size [100]: 1500
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending S, 1500-byte ICMP Echos to 172. .24, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/37/68 ms
Main6509MSFC-A#ping
Protocol [ip]:
Target IP address: 172. .24
Repeat count [5]:
Datagram size [100]: 1500
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending S, 1500-byte ICMP Echos to 172. .24, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/25/32 ms
Main6509MSFC-A#ping
Protocol [ip]:
Target IP address: 10. .114
Repeat count [5]:
Datagram size [100]: 1500
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending S, 1500-byte ICMP Echos to 10. .114, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/6/8 ms
Main6509MSFC-A#
```

```
Main6509MSFC-A#traceroute 10. .114 ← Note: 5
Type escape sequence to abort.
Tracing the route to 10. .114
 0 10. 250 0 msec 0 msec 0 msec
 1 172. .2 0 msec 0 msec 0 msec
 2 172. .22 4 msec 4 msec 4 msec
 3 172. .38 4 msec 4 msec 4 msec
 4 172. .58 4 msec 4 msec 4 msec
 5 172. .72 4 msec 4 msec 4 msec
 6 172. .88 4 msec 4 msec 4 msec
 7 172. .10 12 msec 8 msec 8 msec
 8 172. .15 4 msec 8 msec 4 msec
 9 10. .114 4 msec 4 msec 4 msec
Main6509MSFC-A#
```

Ping sent from main data center to Eastern end of wireless WAN.

- Note 1: Ping AP client connected to MPLS at furthest point of network. TX/RX -81
- Note 2: Trace to AP client demonstrating hop over VPLS tunnel.
- Note 3: Ping same AP client with 1500 byte packet.
- Note 4: Ping router board/AP with 1500 byte packet.
- Note 5: Trace to router/AP demonstrating hops over label switch path.



# System Performance

admin@ (USSCREF-800) - WinBox v5.22 on RB800 (powerpc)

Safe Mode

Firewall

Filter Rules NAT Mangle Service Ports Connections Address Lists Layer7 Protocols

Find all

#	Action	Chain	Src. Address	Dst. Address	Proto	Src. Port	Dst. Port	In. Inter...	Out. Int...	Bytes	Packets
22	POP3	mar...	prerouting		6 tcp		110			0 B	0
23	MOM	mar...	prerouting		6 tcp		1271			0 B	0
24	NTP	mar...	prerouting		17 udp		123			161.7 KB	2 164
25	SNMP	mar...	prerouting		17 udp		161			9.8 MB	123 192
26	NETBIOS	mar...	prerouting		17 udp		137			876.0 KB	11 321
27	SNMP	mar...	prerouting		6 tcp		162			0 B	0
28	SNMP	mar...	prerouting		17 udp		162			0 B	0
29	BGP-src	mar...	prerouting		6 tcp	179				30.8 KB	513
30	BGP-dst	mar...	prerouting		6 tcp		179			61.4 KB	1 022
31	LDP-discovery-dst	mar...	prerouting		17 udp		646			487.3 KB	8 049
32	LDP-discovery-src	mar...	prerouting		17 udp	646				487.2 KB	8 046
33	LDP-session-dst	mar...	prerouting		6 tcp		646			75.7 KB	948
34	LDP-session-src	mar...	prerouting		6 tcp	646				26.5 KB	446
35	SAP	mar...	prerouting		6 tcp						
36	SMTP	mar...	prerouting		6 tcp		3389			3560.2 KB	53 727
37	Syslog	mar...	prerouting		6 tcp		2000,2443			149.6 KB	3 238
38	FTPS	mar...	prerouting		17 udp		5060-5061			0 B	0
39	FTPS	mar...	prerouting		17 udp		6667			0 B	0
40	FTPS	mar...	prerouting		6 tcp		8291			5.3 MB	76 557
41	FTPS	mar...	prerouting		6 tcp					138.3 KB	3 015
42	SPOP3	mar...	prerouting		6 tcp					11.2 KB	220
43	Remote Desktop	mar...	prerouting		6 tcp						
44	SOCCP	mar...	prerouting		6 tcp						
45	SIP	mar...	prerouting		17 udp						
46	IRC	mar...	prerouting		17 udp						
47	Winbox	mar...	prerouting		6 tcp						
48	VOIP CUCM1	mar...	prerouting	10	7						
49	VOIP CUCM2	mar...	prerouting	10	7						

OS WinBox

Use mangle facility to identify and mark packets for assignments to queue This is on a PE router

# System Performance

all								
<a href="#">Rules</a> <a href="#">NAT</a> <a href="#">Mangle</a> <a href="#">Service Ports</a> <a href="#">Connections</a> <a href="#">Address Lists</a> <a href="#">Layer7 Protocols</a>								
Tracking								
Src. Address	Dest. Address	Protocol	Connecti...	Connecti...	P2P	Timeout	TCP State	
2 247.80	7.49871	6 (tcp)		p6		16:35:52	established	
2 247.80	7.49873	6 (tcp)		p6		16:36:07	established	
2 247.80	7.49875	6 (tcp)		p6		16:36:22	established	
2 247.80	7.49883	6 (tcp)		p6		16:36:37	established	
2 247.80	7.49885	6 (tcp)		p6		16:36:52	established	
2 247.80	7.49888	6 (tcp)		p6		16:37:07	established	
2 247.80	7.49895	6 (tcp)		p6		16:37:22	established	
2 247.80	7.49897	6 (tcp)		p6		16:37:37	established	
1 3.49842	7.2000	6 (tcp)		p1		23:59:22	established	
1 3.49835	2000	6 (tcp)		p1		23:59:55	established	
1 3.52257	7.2000	6 (tcp)		p1		23:59:43	established	
1 3.49465	2000	6 (tcp)		p1		23:59:41	established	
1 2.51583	7.2000	6 (tcp)		p1		23:59:14	established	
1 2.50225	2000	6 (tcp)		p1		23:59:27	established	
1 3.50468	2000	6 (tcp)		p1		23:59:55	established	
1 3.49276	7.2000	6 (tcp)		p1		23:59:21	established	
1 3.51299	2000	6 (tcp)		p1		23:59:47	established	
1 3.49153	7.2000	6 (tcp)		p1		23:59:07	established	
1 3.15401	7.2000	6 (tcp)		p1		23:59:13	established	
1 3.15134	2000	6 (tcp)		p1		23:59:43	established	
1 3.51548	7.2000	6 (tcp)		p1		23:59:34	established	
1 3.50644	2000	6 (tcp)		p1		23:59:46	established	
1 2.52483	7.2000	6 (tcp)		p1		23:59:37	established	
1 2.50739	2000	6 (tcp)		p1		23:59:47	established	
1 3.50969	7.2000	6 (tcp)		p1		23:59:00	established	
1 3.50791	2000	6 (tcp)		p1		23:59:41	established	
1 3.52227	7.2000	6 (tcp)		p1		23:59:11	established	
1 3.50019	2000	6 (tcp)		p1		23:59:52	established	
1 3.52301	7.2000	6 (tcp)		p1		23:59:13	established	
1 3.51487	2000	6 (tcp)		p1		23:59:55	established	
1 2.50952	7.2000	6 (tcp)		p1		23:59:13	established	
1 2.50696	2000	6 (tcp)		p1		23:59:28	established	
1 61029	1720	6 (tcp) Q.931		p1		23:59:55	established	
1 53914	60807	6 (tcp) H.245		p1		00:04:55	established	
1 1.1537	2.8291	6 (tcp)		p1		00:04:54	established	
1 0395	7.2000	6 (tcp)		p1		23:59:31	established	
1 047	7.2000	6 (tcp)		p1		23:59:38	established	
1 827	2000	6 (tcp)		p1		23:59:38	established	
1 090	2000	6 (tcp)		p1		23:59:31	established	
1 52884	7.2000	6 (tcp)		p1		23:59:16	established	
1 52615	2000	6 (tcp)		p1		23:59:47	established	
1 1921	7.2000	6 (tcp)		p1		23:59:07	established	
1 0849	2000	6 (tcp)		p1		23:59:32	established	
1 1186	7.2000	6 (tcp)		p1		23:59:25	established	
1 9273	2000	6 (tcp)		p1		23:59:49	established	
1 0851	7.2000	6 (tcp)		p1		23:58:57	established	
1 0850	2000	6 (tcp)		p1		23:59:53	established	
1 2009	7.2000	6 (tcp)		p1		23:58:59	established	
1 9752	2000	6 (tcp)		p1		23:59:55	established	
1 1141	3389	6 (tcp)		p1		23:59:54	established	
1 4037	3389	6 (tcp)		p1		23:59:20	established	
1 58290	3389	6 (tcp)		p1		22:51:38	established	
1 52618	1.171.80	6 (tcp)		p4		23:59:32	established	
1 61800	6.0000	6 (tcp)		p6		22:59:23	established	

Items out of 737

Max Entries: 481448

Some traffic marking with priority at CE





# Reference Material

- [http://wiki.mikrotik.com/wiki/Manual:MPLS/EXP\\_bit\\_behaviour](http://wiki.mikrotik.com/wiki/Manual:MPLS/EXP_bit_behaviour)
- <http://wiki.mikrotik.com/wiki/MPLSVPLS>
- [http://wiki.mikrotik.com/wiki/BGP\\_based\\_VPLS](http://wiki.mikrotik.com/wiki/BGP_based_VPLS)
- **[MUM US09: MPLS by Janis Megis](#)**
- [Routerboard MTU](#)
- [MPLS TE](#)

# Conclusion

Thank You for your time...