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

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.

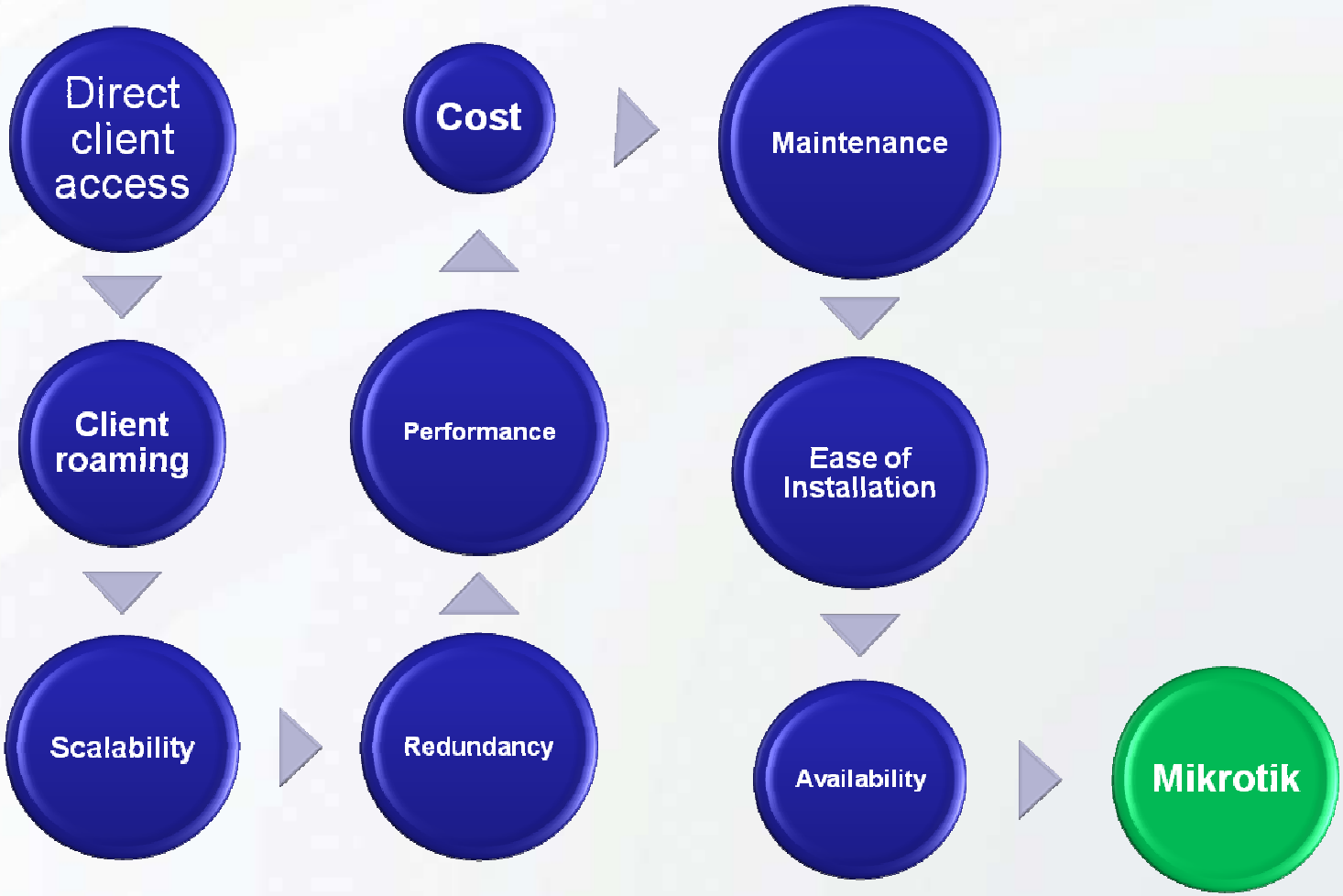
Operational Excellence

- 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.

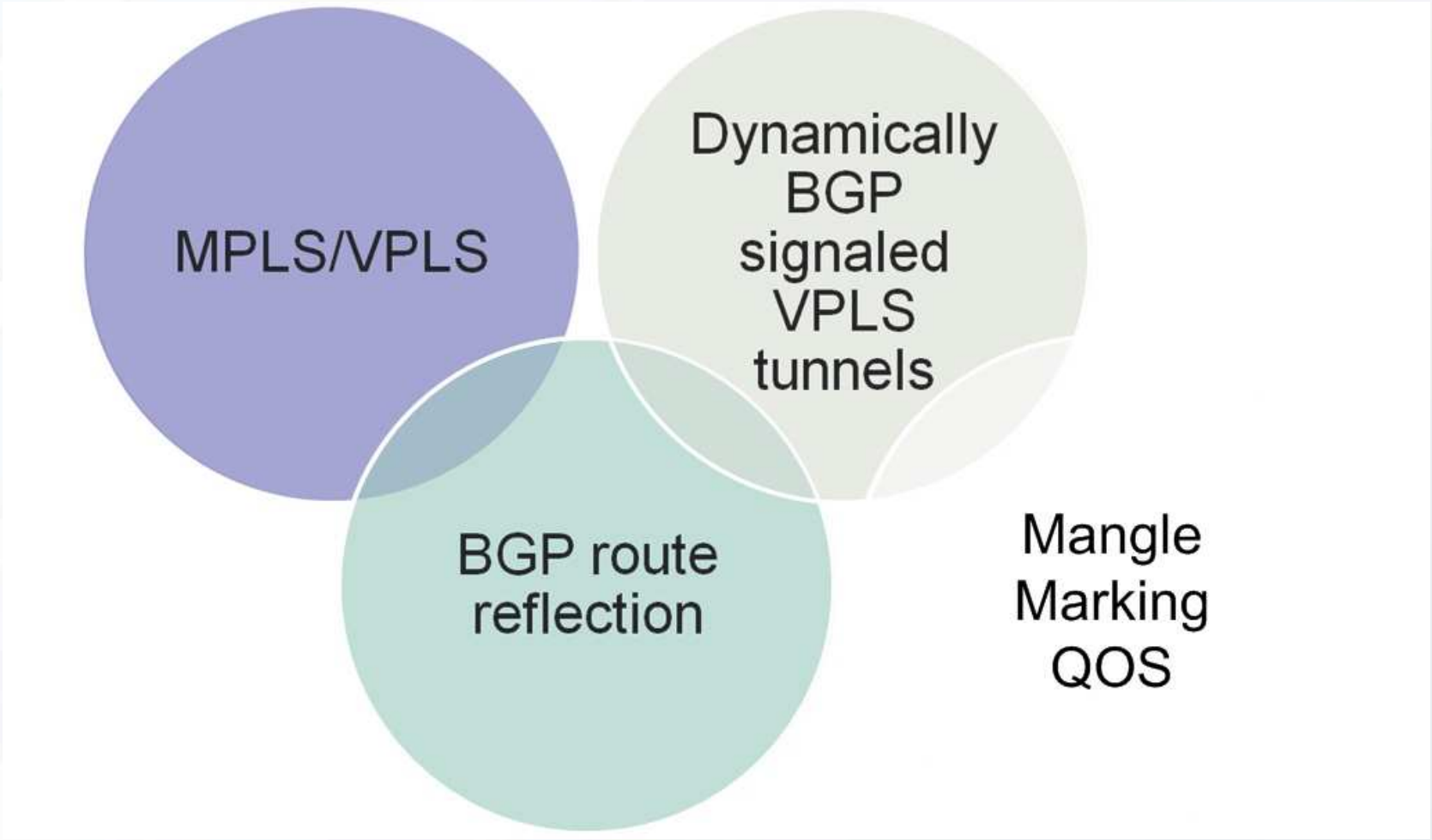
Operational Excellence

- 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, sntp, dhcp as example.

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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.

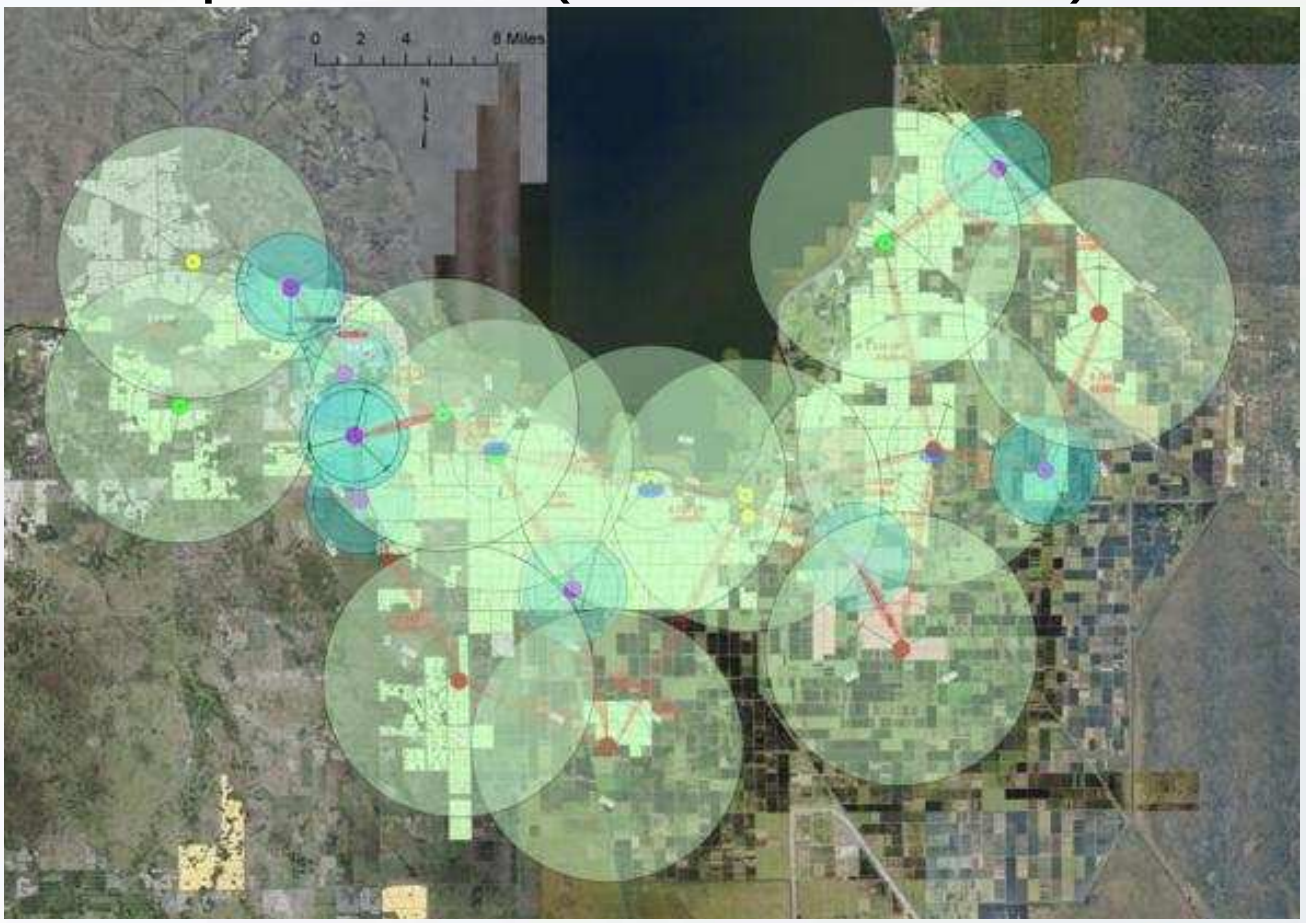
Connect your client interfaces with VPLS again decisions here for static or dynamic considering scale, now and in the future.

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.



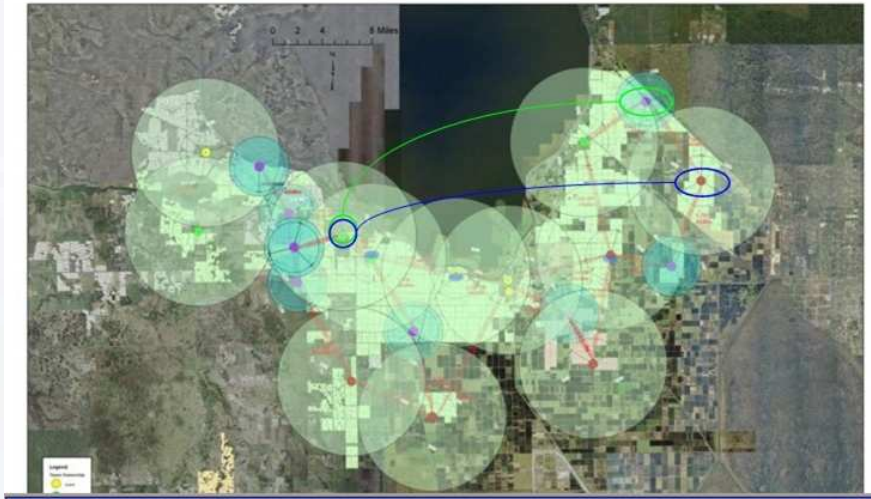
Our System

Quite a large chunk of Florida.

Our System

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.



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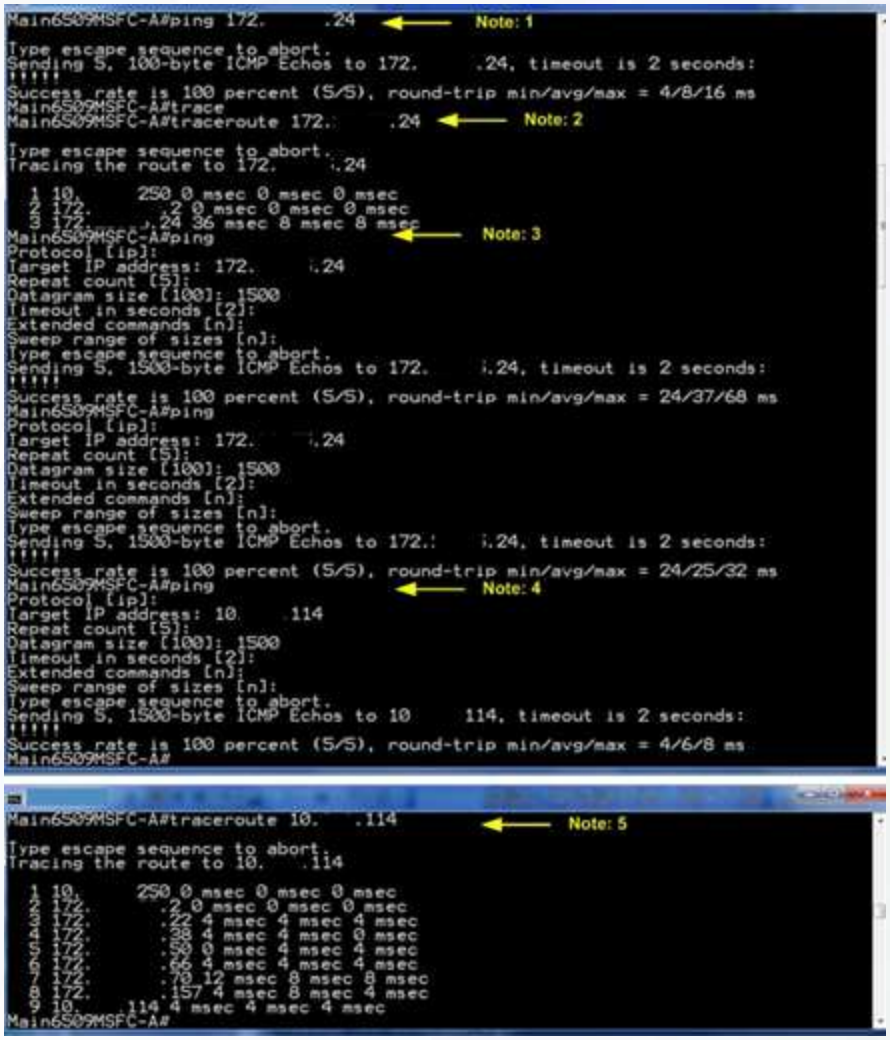
Terminal (Disconnected)

FTW
[admin@USSCREF-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@USSCREF-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@USSCREF-450G] > quit
interrupted
```

System Performance



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.

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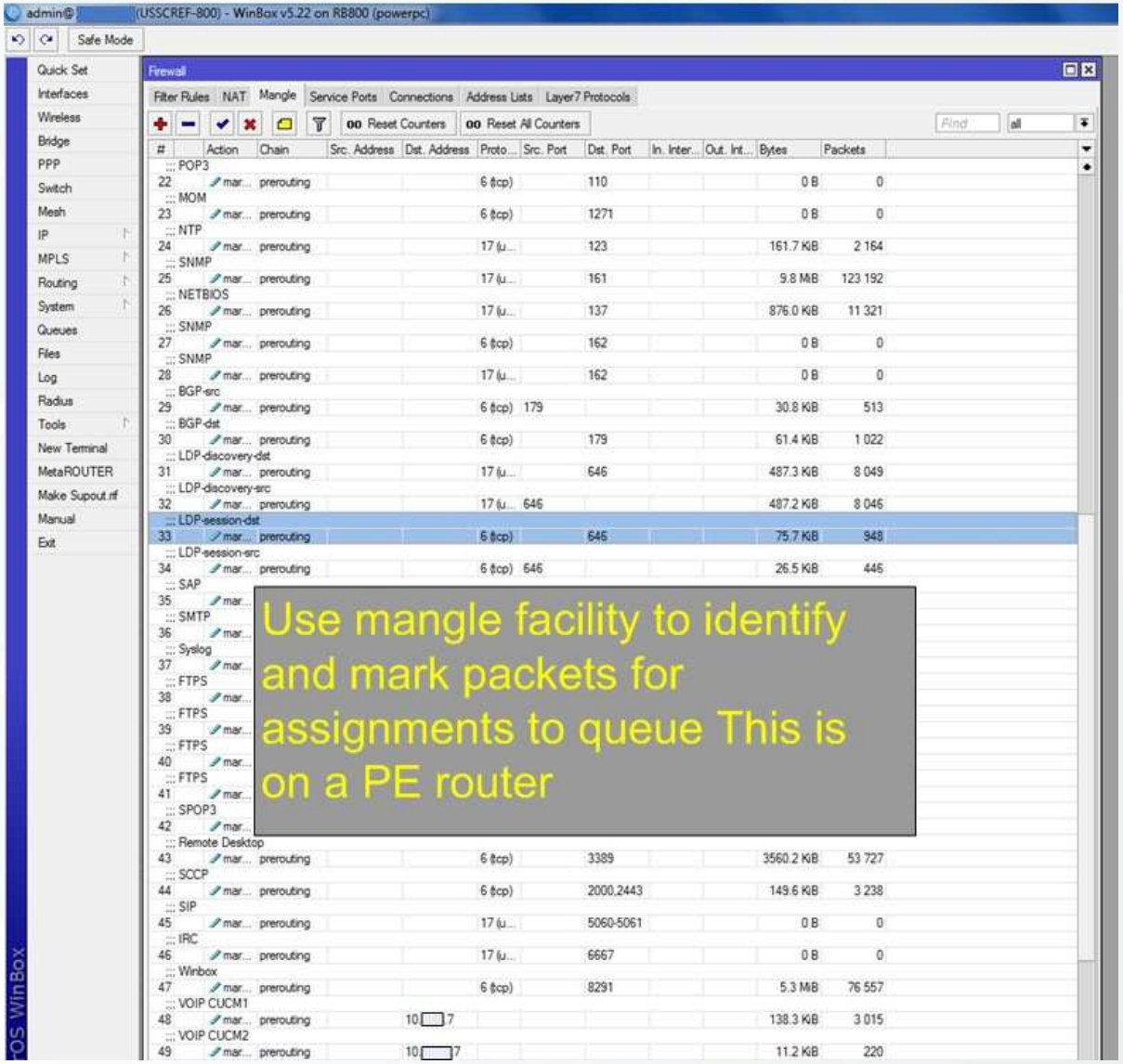
System Performance



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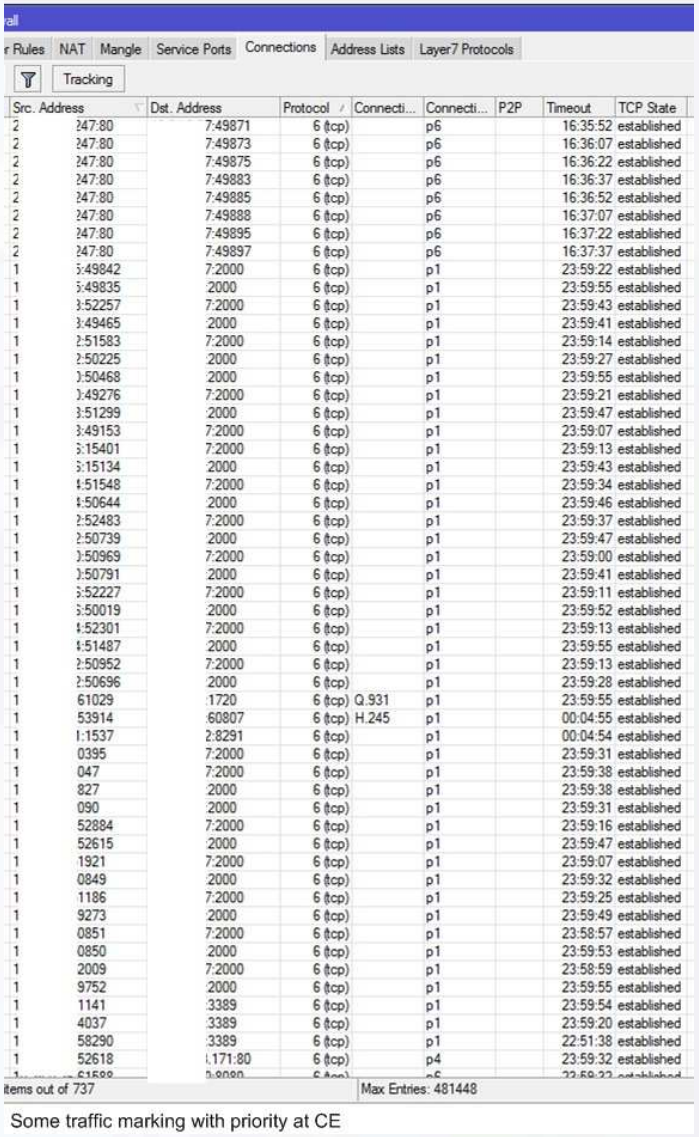
System Performance



all

r Rules | NAT | Mangle | Service Ports | Connections | Address Lists | Layer7 Protocols

Tracking

Src. Address	Dst. 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 5:49842	7:2000	6 (tcp)		p1		23:59:22	established
1 5:49835	: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 4:51548	7:2000	6 (tcp)		p1		23:59:34	established
1 4:50644	: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 4:52301	7:2000	6 (tcp)		p1		23:59:13	established
1 4:51487	: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	.171:80	6 (tcp)		p4		23:59:32	established

items out of 737 | Max Entries: 481448

Some traffic marking with priority at CE

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Reference Material

- http://wiki.mikrotik.com/wiki/Manual:MPLS/EXP_bit_behaviour
- http://wiki.mikrotik.com/wiki/MPLSVPLS
- http://wiki.mikrotik.com/wiki/BGP_based_VPLS
- **MUM US09: MPLS by Janis Megis**
- Routerboard MTU
- MPLS TE

Conclusion

Thank You for your time…