



Shared IT Services for Higher Education & Research

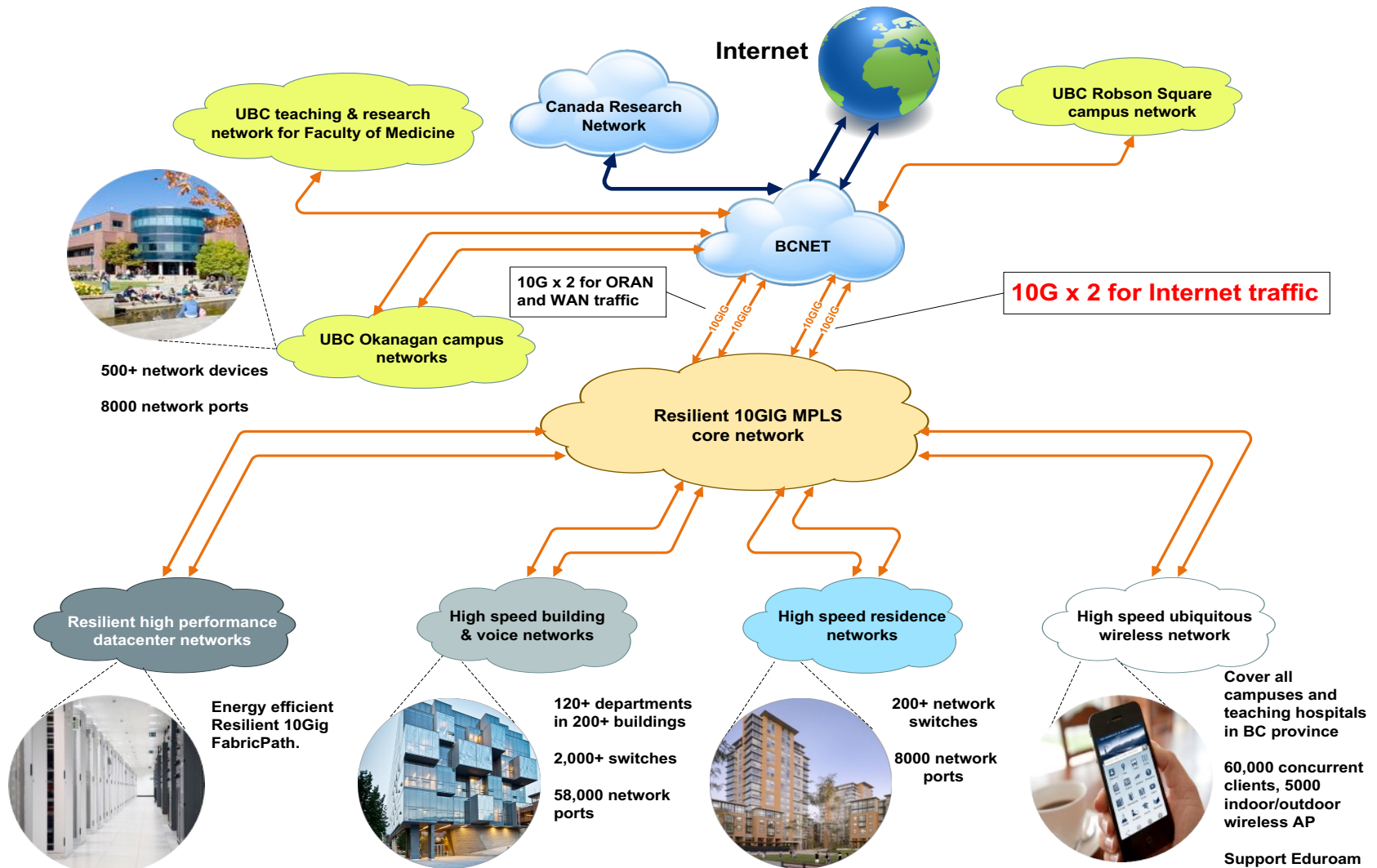
Conference 2017



Traffic Shaping at UBC Internet Border

University of British Columbia
Network Management Centre

High Level of UBC Network Overview



Three Types of Traffic at UBC Border

- Inter-campuses and teaching hospitals traffic
- Research network traffic(ORAN)
- Internet traffic
 - Transit Exchange (TX)
 - Peering(IX)
- Two 10G fibers for Internet traffic to BCNET
- Redundant path and share the traffic

Group Classification in TX Traffic

- All IPs
 - All IP ranges used in UBC Vancouver campus
- Resident network
 - IP ranges assigned to residents on the campus
- VPN
 - IP ranges assigned to remote access VPN users
- Wireless
 - IP ranges assigned to regular wireless users
 - IP ranges assigned to visitors in the campus

The Policy For Shaping TX Traffic

- Avoid shaping ordinary academic traffic
- Shaping P2P traffic based on different groups

Incoming											
Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat.	Max Lat.	Avg Q	Max Q
bB-B9uqWlqH	13.5k	107.0k	184.0 Mbps	0 bps	68.3 kpps	0 pps	0	0	0	0	0
Outgoing											
Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat.	Max Lat.	Avg Q	Max Q
PB-Bandwidth	13.5k	107.0k	184.0 Mbps	0 bps	68.3 kpps	0 pps	0	0	0	0	0
Bi-Directional											
Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat.	Max Lat.	Avg Q	Max Q
UBCAcademic-UBCVisitorP2PShaping	0	146.0	608.0 bps	12.1 kbps	0 pps	5.0 pps	5.0	1,000.0	1,000.0	997.0	1,720.0
UBCAcademic-VPNClientP2PShaping	0	254.0	1,040.0 bps	26.7 kbps	1.0 pps	23.0 pps	23.0	1,000.0	1,000.0	690.0	1,523.0

- Use **Volume Based Shaping (VBS)** to set up quota for certain groups

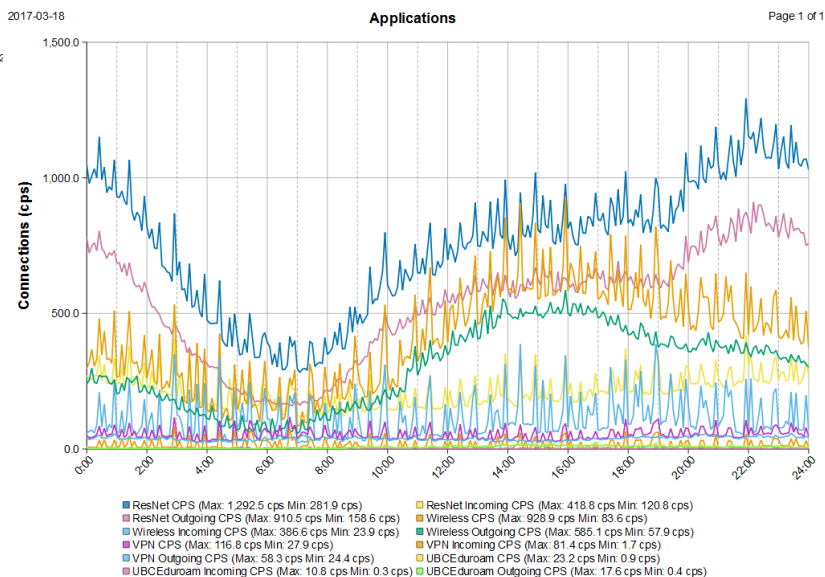
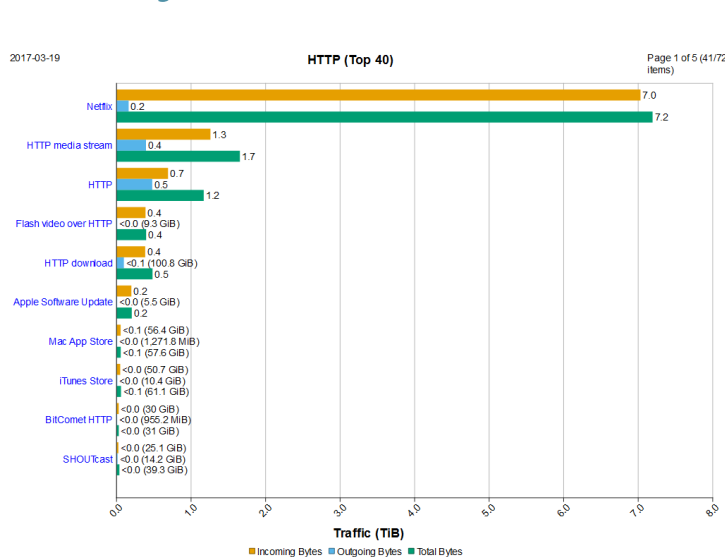
bB-B9uqWlqH-VB2-00f-T	0	184.0	18.1 kbps	0 bps	18.0 bps	0 bps	0	0	0	0	0
bB-B9uqWlqH-VB2-1U-T	0	408.0	435.0 kbps	533.3 kbps	182.0 bps	34.0 bps	34.0	48.0	184.0	1,501.0	2,112.0

- Ad-hoc traffic shaping

Incoming											
Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat.	Max Lat.	Avg Q	Max Q
Apple-upgrade-shaping	11.0	17.0	123.5 Mbps	0 bps	10.7 kpps	0 pps	0	0	8.0	11.4k	605.5k

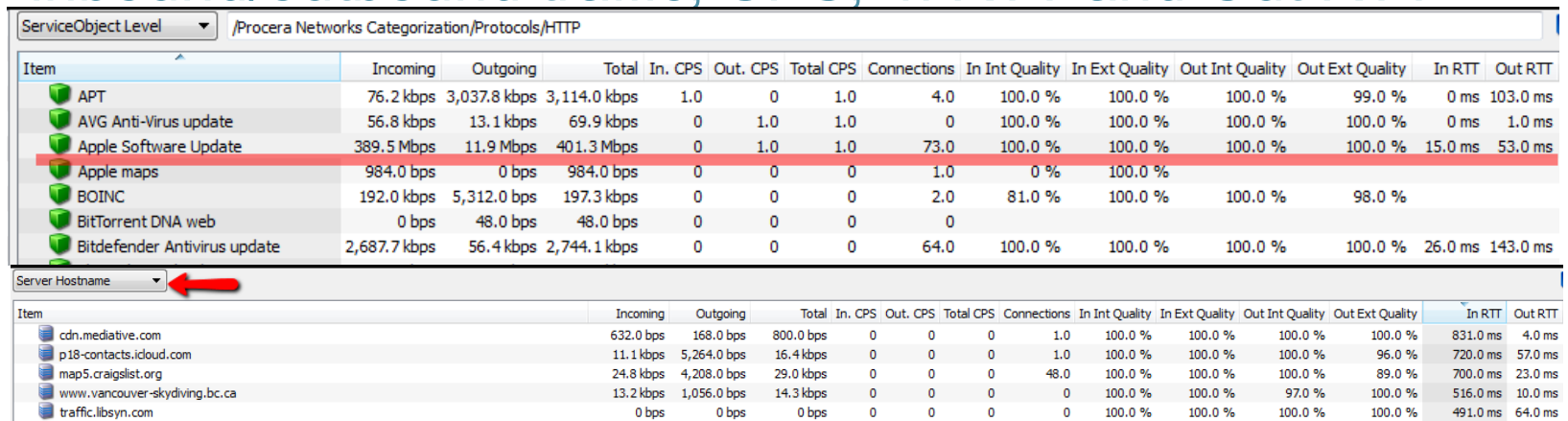
Analyze TX Traffic

- Analyze TX traffic based on service categories
- Analyze TX traffic based on network groups
- Analyze TX traffic volume
- Analyze TX traffic connections



Real Time Statistics for Troubleshooting

- Shows a lot of useful statistics of an individual IP, network groups, a service and a category of service i.e. inbound/outbound traffic, CPS, In RTT and Out RTT.



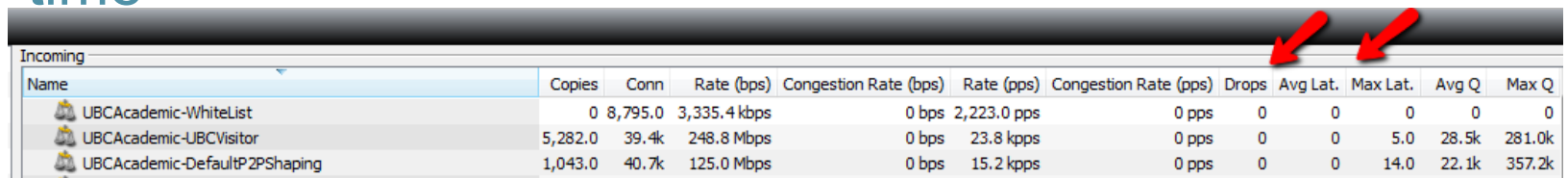
ServiceObject Level: /Provera Networks Categorization/Protocols/HTTP

Item	Incoming	Outgoing	Total	In. CPS	Out. CPS	Total CPS	Connections	In Int Quality	In Ext Quality	Out Int Quality	Out Ext Quality	In RTT	Out RTT
APT	76.2 kbps	3,037.8 kbps	3,114.0 kbps	1.0	0	1.0	4.0	100.0 %	100.0 %	100.0 %	99.0 %	0 ms	103.0 ms
AVG Anti-Virus update	56.8 kbps	13.1 kbps	69.9 kbps	0	1.0	1.0	0	100.0 %	100.0 %	100.0 %	100.0 %	0 ms	1.0 ms
Apple Software Update	389.5 Mbps	11.9 Mbps	401.3 Mbps	0	1.0	1.0	73.0	100.0 %	100.0 %	100.0 %	100.0 %	15.0 ms	53.0 ms
Apple maps	984.0 bps	0 bps	984.0 bps	0	0	0	1.0	0 %	100.0 %				
BOINC	192.0 kbps	5,312.0 bps	197.3 kbps	0	0	0	2.0	81.0 %	100.0 %	100.0 %	98.0 %		
BitTorrent DNA web	0 bps	48.0 bps	48.0 bps	0	0	0	0						
Bitdefender Antivirus update	2,687.7 kbps	56.4 kbps	2,744.1 kbps	0	0	0	64.0	100.0 %	100.0 %	100.0 %	100.0 %	26.0 ms	143.0 ms

Server Hostname

Item	Incoming	Outgoing	Total	In. CPS	Out. CPS	Total CPS	Connections	In Int Quality	In Ext Quality	Out Int Quality	Out Ext Quality	In RTT	Out RTT
cdn.mediate.com	632.0 bps	168.0 bps	800.0 bps	0	0	0	1.0	100.0 %	100.0 %	100.0 %	100.0 %	831.0 ms	4.0 ms
p18-contacts.icloud.com	11.1 kbps	5,264.0 bps	16.4 kbps	0	0	0	1.0	100.0 %	100.0 %	100.0 %	96.0 %	720.0 ms	57.0 ms
map5.craigslist.org	24.8 kbps	4,208.0 bps	29.0 kbps	0	0	0	48.0	100.0 %	100.0 %	100.0 %	89.0 %	700.0 ms	23.0 ms
www.vancouver-skydiving.bc.ca	13.2 kbps	1,056.0 bps	14.3 kbps	0	0	0	0	100.0 %	100.0 %	100.0 %	97.0 %	516.0 ms	10.0 ms
traffic.libsyn.com	0 bps	0 bps	0 bps	0	0	0	0	100.0 %	100.0 %	100.0 %	100.0 %	491.0 ms	64.0 ms

- Displays shaping drops and latency information in real time



Incoming

Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat.	Max Lat.	Avg Q	Max Q
UBCAcademic-WhiteList	0	8,795.0	3,335.4 kbps	0 bps	2,223.0 pps	0 pps	0	0	0	0	0
UBCAcademic-UBCVisitor	5,282.0	39.4k	248.8 Mbps	0 bps	23.8 kpps	0 pps	0	0	5.0	28.5k	281.0k
UBCAcademic-DefaultP2PShaping	1,043.0	40.7k	125.0 Mbps	0 bps	15.2 kpps	0 pps	0	0	14.0	22.1k	357.2k

Search Function For Investigation

- Search for top users of a specific service i.e. Netflix offline
- Audit for specific traffic i.e. 901-904/tcp
- Identify weird behaviours of a host i.e. excessive ssh access

Service: Netflix offline

Max results: 500

Reset Export... Search

Client	Server	Client Port	Server Port	Protocol	Service	Server Hostname	Incoming	Outgoing
226.13	184.150.14.131	57714	80	TCP	Netflix offline	184.150.14.131	530.31 MB	9.06 MB
34.153	184.150.14.139	60072	80	TCP	Netflix offline	184.150.14.139	472.6 MB	13.82 MB
251.177	184.150.14.195	58126	80	TCP	Netflix offline	184.150.14.195	470.12 MB	18.03 MB
226.13	184.150.14.205	58832	80	TCP	Netflix offline	184.150.14.205	410.87 MB	8.4 MB
251.177	184.150.14.201	57256	80	TCP	Netflix offline	184.150.14.201	407.82 MB	15.81 MB
5.61	184.150.14.143	59475	80	TCP	Netflix offline	184.150.14.143	365.93 MB	7.53 MB
226.13	184.150.14.143	58825	80	TCP	Netflix offline	184.150.14.143	321.71 MB	6.95 MB
201.48	184.150.14.213	49283	80	TCP	Netflix offline	184.150.14.213	318.22 MB	11.13 MB
226.13	184.150.14.197	58828	80	TCP	Netflix offline	184.150.14.197	290.37 MB	5.73 MB
251.177	184.150.14.129	57990	80	TCP	Netflix offline	184.150.14.129	275.42 MB	10.37 MB
153.93	184.150.14.211	49408	80	TCP	Netflix offline	184.150.14.211	181.98 MB	2,042.67 KiB
30.2	184.150.14.193	49624	80	TCP	Netflix offline	184.150.14.193	174.62 MB	6.37 MB
251.115	184.150.14.201	49408	80	TCP	Netflix offline	184.150.14.201	158.28 MB	4.16 MB
142.45	184.150.14.133	61912	80	TCP	Netflix offline	ipv4_l1agg0.c003.yyz2003.belcanada.isp.netflixvideo.net	148.31 MB	4.48 MB
79.236	184.150.14.205	41997	80	TCP	Netflix offline	184.150.14.205	144.02 MB	4.13 MB
199.193	184.150.14.199	51477	80	TCP	Netflix offline	184.150.14.199	136.15 MB	4.74 MB
142.45	184.150.14.199	61905	80	TCP	Netflix offline	184.150.14.199	135.71 MB	3.74 MB
4.154	184.150.14.147	50373	80	TCP	Netflix offline	184.150.14.147	134.3 MB	3.31 MB
199.193	184.150.14.203	51527	80	TCP	Netflix offline	184.150.14.203	124.39 MB	4.27 MB
199.193	184.150.14.207	51488	80	TCP	Netflix offline	184.150.14.207	89.96 MB	3.16 MB
15.188	184.150.14.131	52354	80	TCP	Netflix offline	184.150.14.131	89.72 MB	2.94 MB

Close

PacketLogic - Connection Search

Server IPv4 address range: 0.1 to :55.255

Protocol: TCP

Server port range: 901 to 904

Start time interval: 2017-03-20 00:00:00 to 2017-03-23 00:00:00

Max results: 500

Reset Export... Search

Start Time	End Time	Client	Server	Client Port	Server Port	Protocol	Serv
No connections found!							

Close

Considerations of Shaping Traffic at Border

- It has limited effect to shape the inbound traffic from ISP.
- It can detect volume and connection based DoS and DDoS attacks, but cannot stop inbound attacks.
- It is very effective to shaping outbound traffic to ISP.
- How to fair share the shaped bandwidth with all hosts?
- How to categorize or group services and hosts to apply proper shaping policies?
- How to apply the shaping policy per IP (client) or per user id (multiple devices)?
- HW resource limitation.



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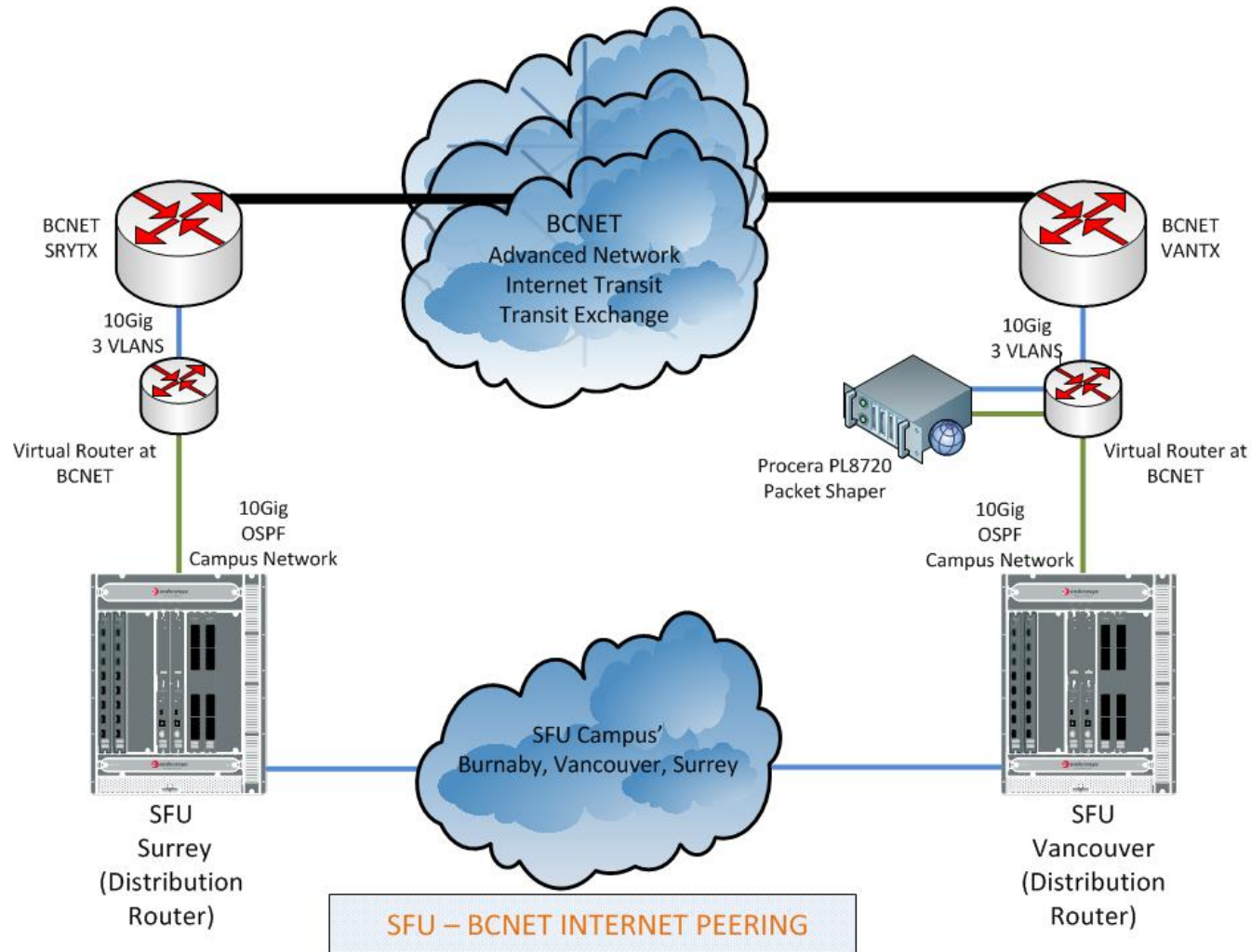
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Traffic Shaping In Higher Education

Simon Fraser University
ITS – Network Services

SFU Internet Connections



Three Traffic Sources at the Border

- Research (ORAN)
- Transit Exchange (TX)
- Peering (IX)

- One 10Gig Interface in Vancouver with a Procera PL8720 to BCNET (VANTX)
- One 10Gig Interface in Surrey (Backup via BGP)












Traffic Classification

- All SFU IP ranges are assigned to one of four traffic priorities for shaping
- Traffic priorities in order
 - Datacentre services
 - Hosted data services
 - Campus wired & wireless

Name	Incoming	Outgoing	Incoming CPS	Outgoing CPS	Est. Connections
2nd Highest Priority Networks - Externals	0.3 Mbps	10.3 Mbps	11.0	9.0	622.0
Default Priority Networks - Campus	42.8 Mbps	116.9 Mbps	723.0	190.0	7,266.0
Highest Priority Networks - Data Centres	10.9 Mbps	60.5 Mbps	426.0	87.0	16.2k
Lowest Priority Networks - Wireless	58.8 Mbps	6.1 Mbps	58.0	46.0	2,107.0
<Ungrouped>	0 bps	0.0 Mbps	0	3.0	1.0

Traffic Classification

- Some addresses need to be manually excluded from ranges so they don't get preferential treatment i.e. Linux distro repository
- We can also enter a host or network IP to be blocked

Object name: Highest Priority Networks - Data Centres	
Name/Value	
 DHCP	
 Network: 142.58.100.0/255.255.252.0	
 Network: 142.58.104.0/255.255.254.0	
 Network: 142.58.106.0/255.255.255.0	
 Network: 142.58.109.0/255.255.255.0	
 Network: 142.58.110.0/255.255.255.0	
 Network: 142.58.190.0/255.255.255.0	
 Network: 142.58.95.0/255.255.255.0	
 Network: 142.58.98.0/255.255.255.0	
 Exclude Address: 142.58.101.156	
 Exclude Address: 142.58.104.89	

Traffic Classification

No Residence Internet traffic on our campus network

All student residence Internet services are outsourced

Traffic Classification

- Only inbound TX traffic needs to be shaped as the volume of our outbound

Object name:

Split by:

► Advanced Options

Limits

Show bandwidth rates in

Direction	Bandwidth	Packet rate	Connection rate
Incoming	1,100.00 Mbps	Unlimited	Unlimited
Outgoing	1,100.00 Mbps	Unlimited	Unlimited
Bi-Directional	Unlimited	Unlimited	Unlimited

- We only shape two specific types of traffic
 - Wireless P2P, restricted to 15Mbps
 - Video Conference provider (Blue Jeans) is given higher priority than normal campus traffic

Traffic Monitoring

We also use the packet shaper for monitoring.

By adding rules that don't actually shape traffic but alert at a certain threshold.

Rule monitors concurrent connections with a threshold of 15k.

Traffic Monitoring

PacketLogic - Procera.net.sfu.ca - procera.net.sfu.ca

File Edit View Tools Help

LiveView: Shaping Objects

- Local Hosts
- Service Objects
- Services
- Shaping Objects
- Filtering Rules
- Filtering Log
- Rewrite Log
- Channel Statistics
- Bluejeans Shaping

Incoming

Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat
15K Connection Limit	1.0	572.0	0.8 Mbps	0 bps	1,432.0 pps	0 pps	0	
Commodity Bandwidth	0	286.6k	98.1 Mbps	0 bps	26.2 kpps	0 pps	0	
Host CPS Limit	0	0	0 bps	0 bps	0 pps	0 pps	0	

Outgoing

Name	Copies	Conn	Rate (bps)	Congestion Rate (bps)	Rate (pps)	Congestion Rate (pps)	Drops	Avg Lat
15K Connection Limit	1.0	572.0	17.7 Mbps	0 bps	46.0 pps	0 pps	0	
Commodity Bandwidth	0	286.6k	163.1 Mbps	0 bps	29.1 kpps	0 pps	0	
Host CPS Limit	0	0	0 bps	0 bps	0 pps	0 pps	0	

Bi-Directional

Name	Copies	Conn	Rate (bps)	Rate (bps)	Rate (pps)	Rate (pps)	Drops	Avg Lat
P2P Bandwidth	0	484.0	0.8 Mbps	0 bps	205.0 pps	0 pps	0	0

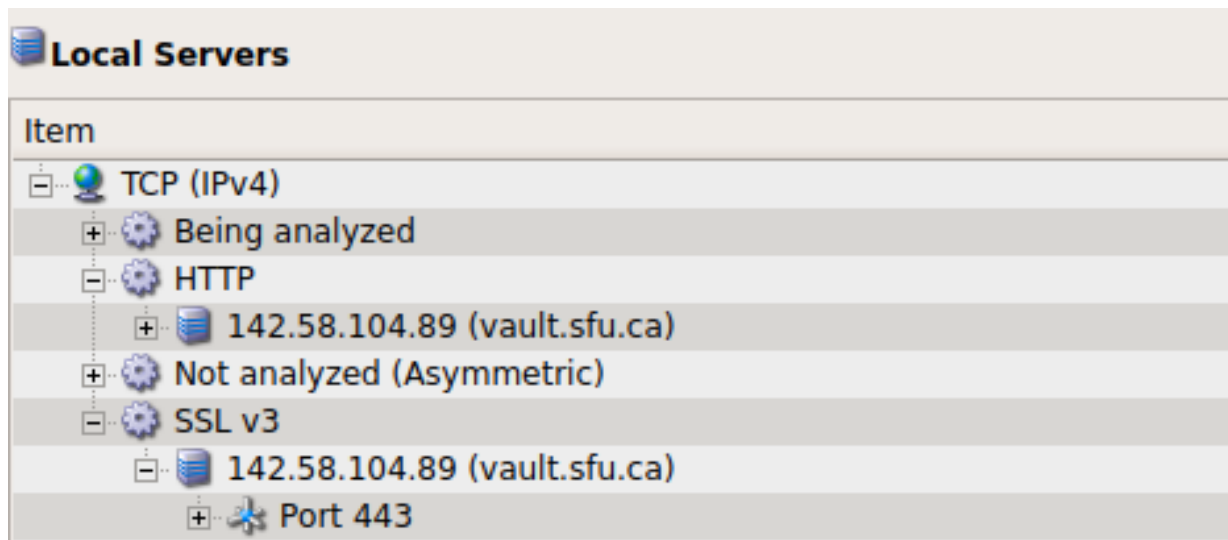
System Overview LiveView

System Diagnostics Statistics

Version: 15.1.4.14 System ID: 000BAB54FE65 System: procera.net.sfu.ca Username: admin 2017-04-23 20:01:41

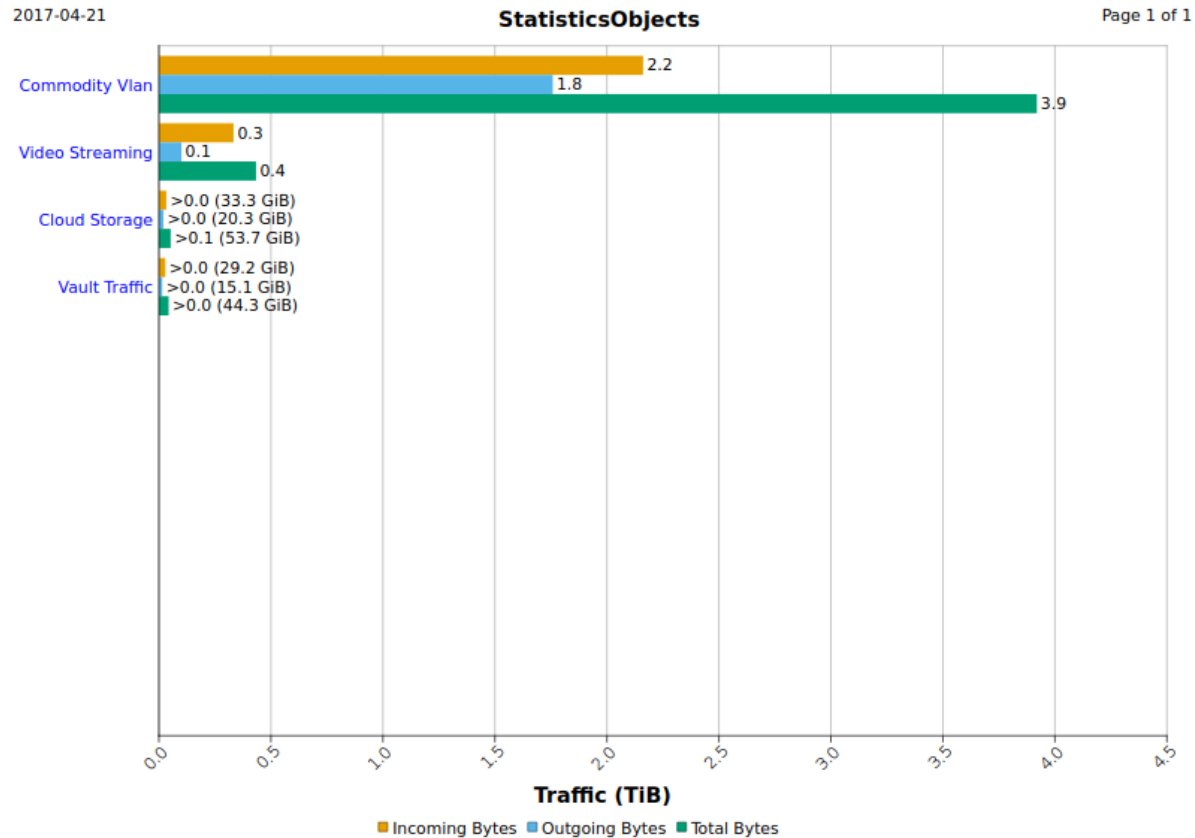
Traffic Reporting

- Real Time



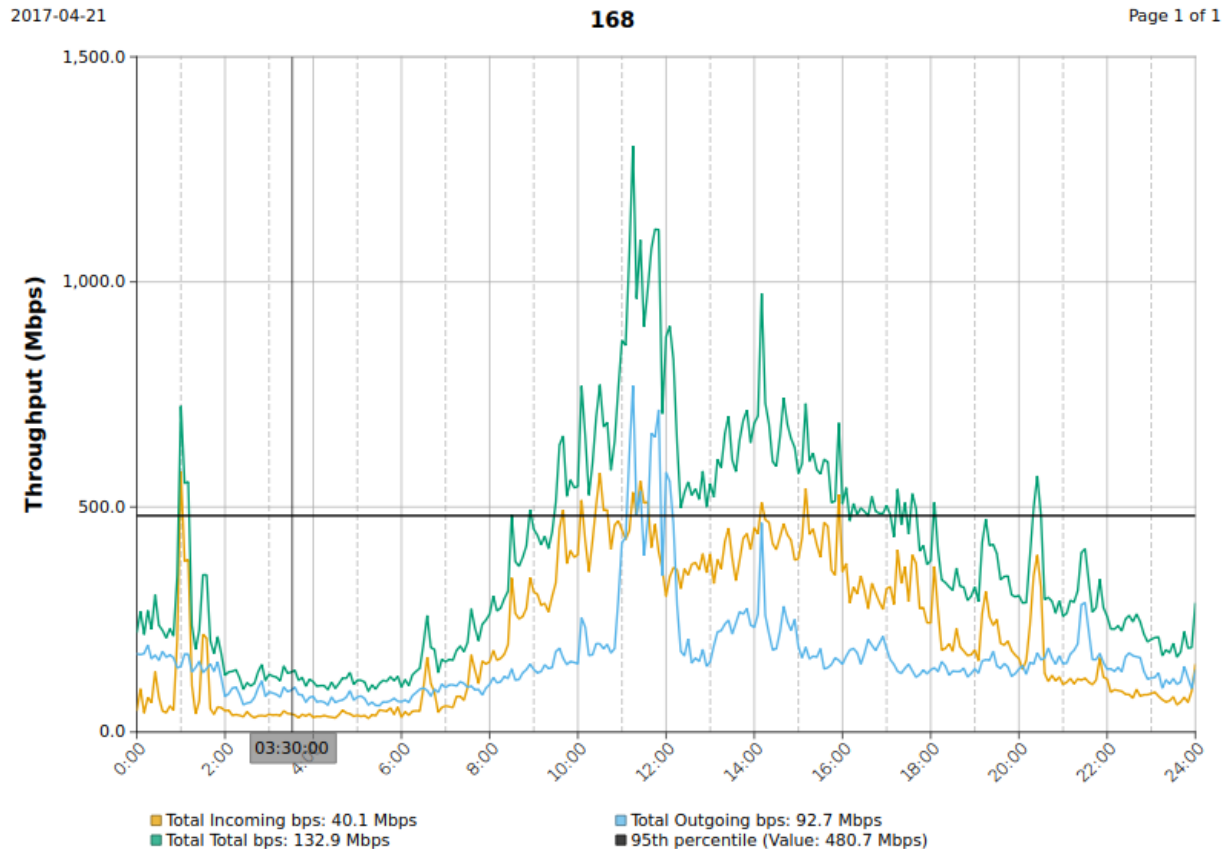
Traffic Reporting

- Trending



Traffic Reporting

- Trending



Q&A