Testing QoS performance in broadband CPE and Wi-Fi gateways

The webinar will begin at :02 past the hour.

Testing QoS

QoS Challenges

- Determining Thresholds and test parameters
- Generate traffic with different DSCP markings from multiple clients
- Create the conditions needed for QoS
- Determine the goodput
- Compare against initial thresholds
- Repeat testing and remain consistent with each test

Test Organization

Divided into 4 modules:

Download

- fixed-dscp-perf-download.tcl
- fixed-dscp-perf-download-v6.tcl

Upload

- fixed-dscp-perf-upload.tcl
- fixed-dscp-perf-upload-v6.tcl

Test Organization

Each module has the same set of tests with different combinations of Application Flow, Background Flow, and Transport Protocol:

- Video (UDP)
- Voice (UDP)
- Bulk (TCP and UDP)
- Best Effort (TCP and UDP)

diffserv4

- Defined by CAKE Queue Management System
  - https://www.bufferbloat.net/projects/codel/wiki/CakeFAQ/

- 4 Tins / Diffserv Markings
  - Bulk (6.25%)
  - Best Effort
  - Video (50%)
  - Voice (25%)

Creating Congestion

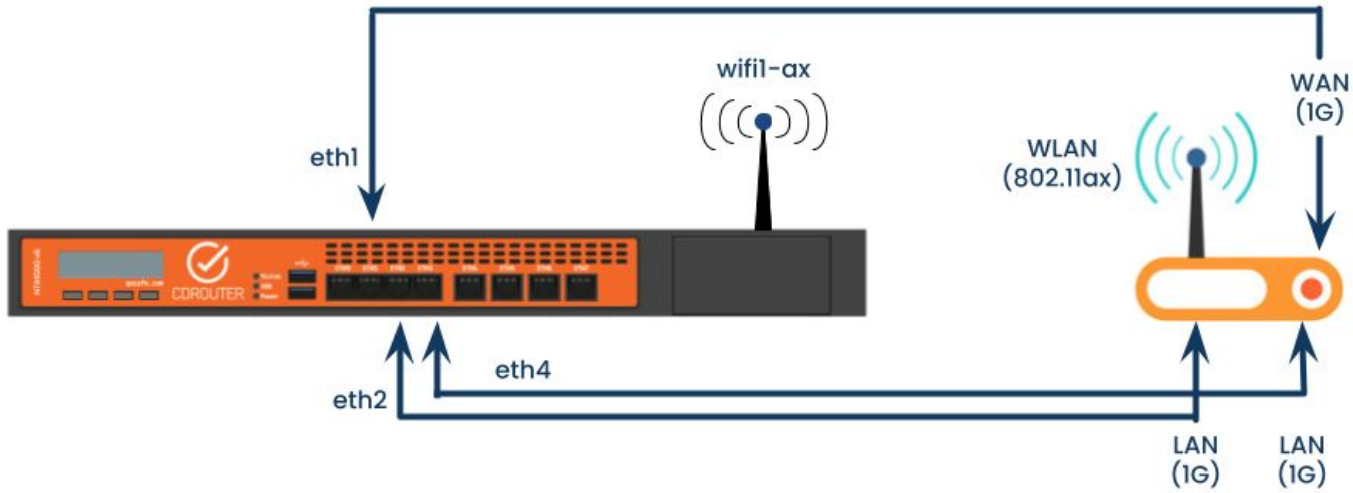
- The DUT must be processing enough traffic to cause QoS Prioritization to be needed to achieve goals

- Ways to do this:
  - Asymmetric WAN/LAN Speeds
  - Asymmetric WAN/LAN Ports
  - Multiple Clients

Setup

Demo Topology

- WAN - 1Gbps
- 3 LAN Clients
  - lan: wifi1-ax
  - lan2: 1Gbps
  - lan3: 1Gbps
- DUT will experience congestion in the *upload* direction when all clients are transmitting at or near line rate



CDRouter Configuration

- *Minimal* CDRouter configuration required
  - Most parameters are *fixed* according to the test case
  - Duration and Port can be modified

- Example:

  perf_dscp_fixed_IPv4_12_download_Voice_UDP_Voice_UDP

  IPv4 Download

  Application Video UDP flow

  Background Voice UDP Flow

DUT Configuration

- Will Vary!

```
root@OpenWrt:~# tc -s qdisc
qdisc noqueue 0: dev lo root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc fq_codel 0: dev eth0 root refcnt 2 limit 1
 Sent 3200509659537 bytes 2154106681 pkt (droppe
 backlog 0b 0p requeues 1434409
  maxpacket 27324 drop_overlimit 3949376 new_flo
  new_flows_len 0 old_flows_len 0
qdisc noqueue 0: dev lan1 root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev lan2 root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev lan3 root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev lan4 root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev wan root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev br-lan root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
qdisc noqueue 0: dev wlan1 root refcnt 2
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 rec
 backlog 0b 0p requeues 0
root@OpenWrt:~#
```

```
qdisc cake 81f1: dev wan root refcnt 2 bandwidth 600Mbit diffserv4 triple-isolate nonat
nowash no-ack-filter split-gso rtt 100ms raw overhead 0
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
 memory used: 0b of 15140Kb
 capacity estimate: 600Mbit
 min/max network layer size:           65535 /       0
 min/max overhead-adjusted size:       65535 /       0
 average network hdr offset:               0

                  Bulk  Best Effort        Video        Voice
  thresh      37500Kbit      600Mbit      300Mbit      150Mbit
  target            5ms          5ms          5ms          5ms
  interval        100ms        100ms        100ms        100ms
  pk_delay          0us          0us          0us          0us
  av_delay          0us          0us          0us          0us
  sp_delay          0us          0us          0us          0us
  backlog           0b           0b           0b           0b
  pkts               0            0            0            0
  bytes              0            0            0            0
  way_inds           0            0            0            0
  way_miss           0            0            0            0
  way_cols           0            0            0            0
  drops              0            0            0            0
  marks              0            0            0            0
  ack_drop           0            0            0            0
  sp_flows           0            0            0            0
  bk_flows           0            0            0            0
  un_flows           0            0            0            0
  max_len            0            0            0            0
  quantum         1144         1514         1514         1514
```

Demo

Test Process

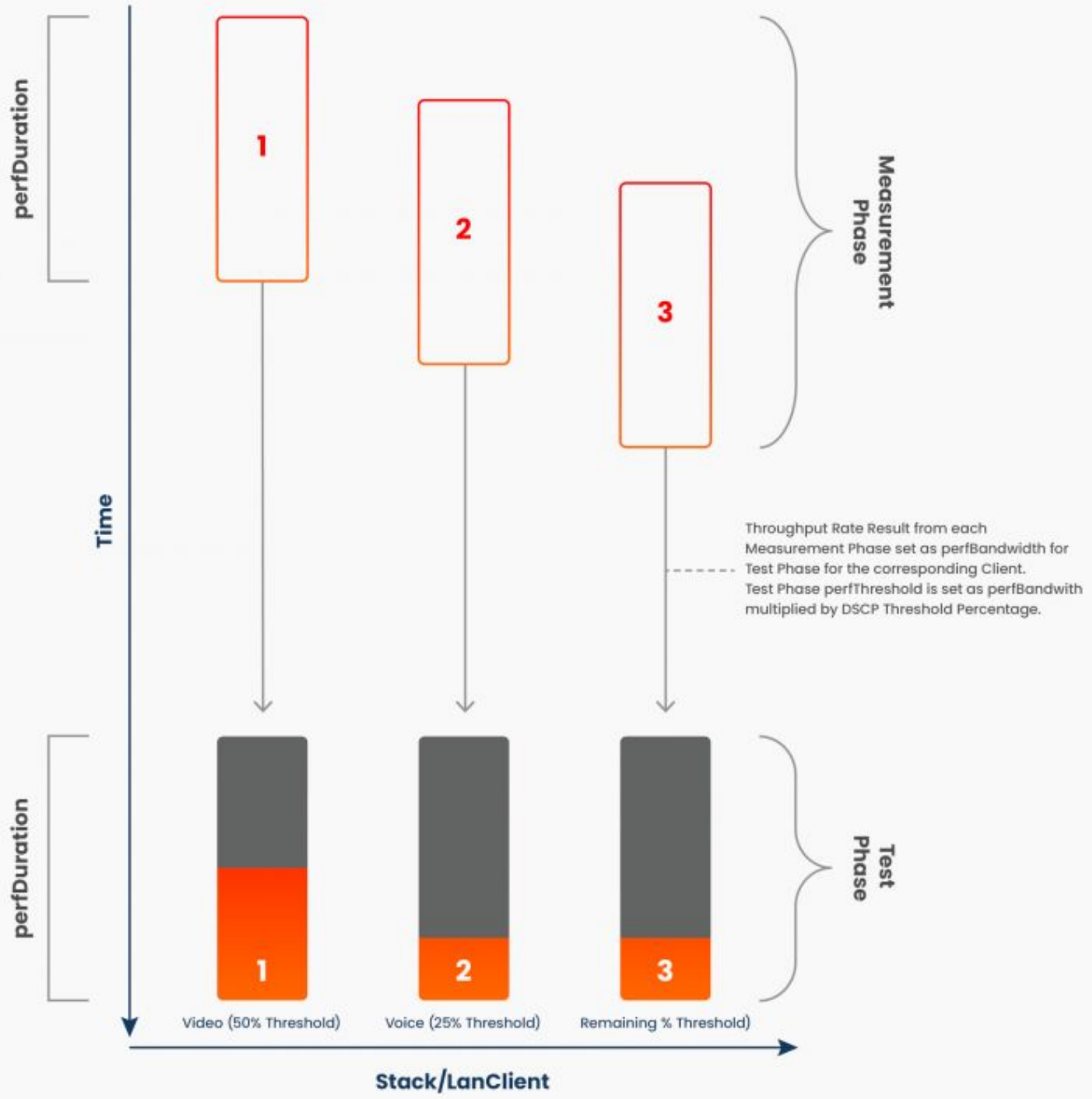
Phase 1: Measure Bandwidth for each LAN Port independently

Duration = # LAN * perfDuration

Phase 2: Test Bandwidth using measured bandwidth and DSCP threshold % for all LAN Ports simultaneously

Duration = perfDuration

Total Duration = Phase 1 Duration + Phase 2 Duration



Results

- Results are based on the measured bandwidth and the expected bandwidth based on the threshold percentage

- e.g. Test Bandwidth must be greater than Expected Threshold

(for all LAN clients)

Measured Bandwidth	900 Mbps	Analogous to *perf*Bandwidth*
Diffserv4 Video Threshold	50 %	
Expected Perf Threshold	450 Mbps	Analogous to perf*Threshold

Wrap Up

Caveats

- Performance Testing is a moving target
  - CDRouter helps create repeatable, consistent results
- QoS DUT Configuration is a tradeoff between simplicity and sophistication
  - Testing with CDRouter will help narrow down which configuration elements are most important to the end-user
- Queuing is CPU intensive, extra flows and processing will impact results
  - CDRouter Traffic Flows and Thresholds ensure ongoing passing results
    - Use in combination with your Stability packages

Additional Resources

- CAKE - www.bufferbloat.net/projects/codel/wiki/CakeFAQ/
- DS Field (RFC 2474) - datatracker.ietf.org/doc/html/rfc2474
- EF PHB (RFC 3246) - datatracker.ietf.org/doc/html/rfc3246
- OpenWRT SQM - openwrt.org/docs/guide-user/network/traffic-shaping/sqm
- CDRouter DSCP Performance Testing - support.qacafe.com/cdrouter/user-guide/cdrouter-performance-user-guide/#dscp-performance-testing
- QA Cafe Article *How to Test DSCP …* - www.qacafe.com/resources/how-to-test-dscp-qos-in-your-broadband-gatewaywi-fi-router/

Re

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  sp_delay          0us          0us          0us          0us
  backlog           0b           0b           0b           0b
  pkts               0            0            0            0
  bytes              0            0            0            0
  way_inds           0            0            0            0
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  way_cols           0            0            0            0
  drops              0            0            0            0
  marks              0            0            0            0
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