



Managing Network QOS

A Cartoon Guide to bandwidth reservation

Presented by:
Date:

Don Westlight
October 2009

<westligh@ohsu.edu>

Cartoon Guide to QOS

What is Network QOS?

bandwidth reservation

- ‘Quality Of Service’ is not a measure of customer satisfaction.
- Wikipedia:
“In computer networking, Quality of Service (QOS) is a traffic engineering term referring to resource reservation control mechanisms rather than achieved service quality.”

Cartoon Guide to QOS

Why reservation might be helpful...



Video Packet

Batman Download

10% packet
Loss
(G711)



networkcomputing.com

Cartoon Guide to QOS

Bandwidth Reservation

- To ensure that high priority packets get through, we intentionally delay or throw away lower priority traffic.
- It is possible for multiple applications to all succeed by meeting their jitter/loss criteria without making a value judgment about one user being more important than another.

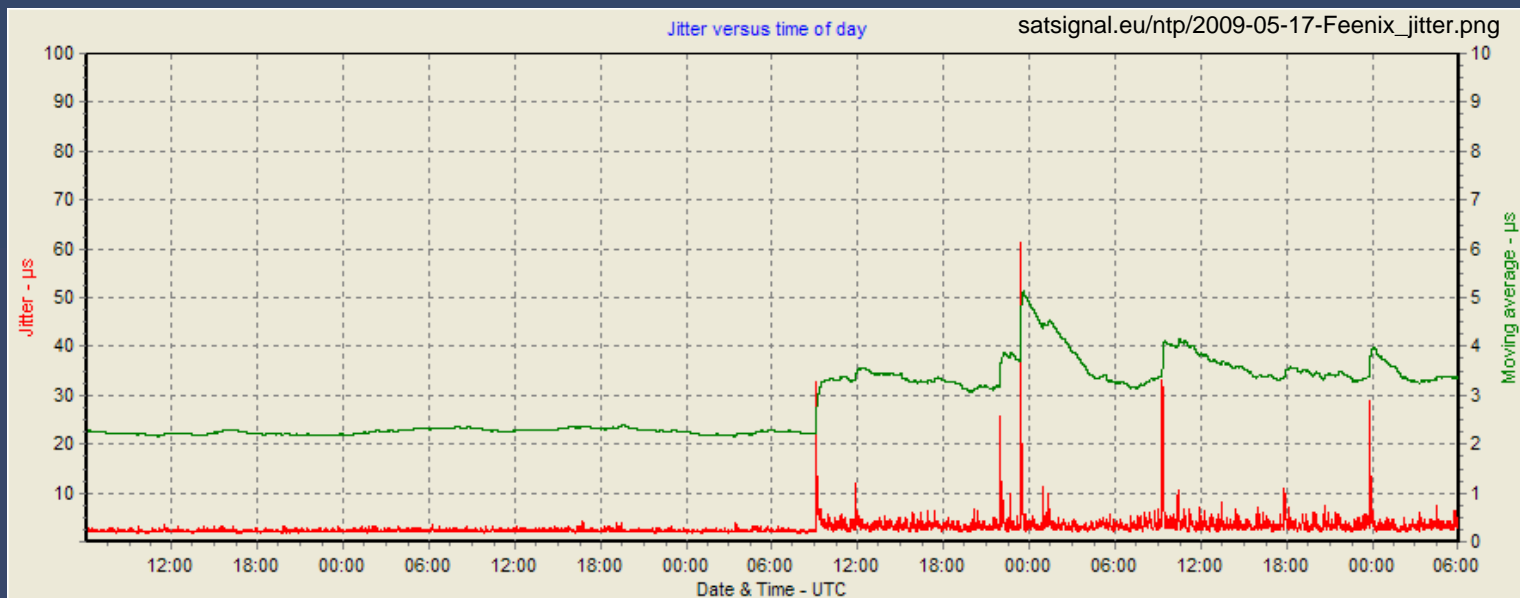
Cartoon Guide to QOS

How is network jitter different than packet loss?

[In class example]



- Jitter is the variability in packet arrival times. If variability is too large, applications quit waiting.
- For voice & video applications: no difference between a late packet and a lost packet. (Unless you want to look like Max Headroom)



Cartoon Guide to QOS

... So why do we need QOS bandwidth reservation anyway?

- Give preferential treatment to a few applications. (The existence of an extra “t” in a voice conversation is the difference between do and don't.)
- Most applications are not sensitive, and should be left alone.
- Maybe deprioritize Batman downloads (mumble mumble “net neutrality” mumble)

Cartoon Guide to QOS

What exactly do we mean by “bandwidth reservation?”

- The best analogy we have is the “carpool lane” on the local freeway. It needs rules, labeling, consideration of merges & traffic flow, and enforcement...
- Road type doesn’t matter: this can be implemented on any combination of bridges, tunnels, or other roadbeds.

Cartoon Guide to QOS

What exactly do we mean?



Cartoon Guide to QOS

What exactly do we mean?

- Imagine a 300 mile continuous carpool lane between this hotel and your house... crossing jurisdictions, intersections, bridges, etc.
- An IP Video Conference is the same (Service providers, equipment, hand-offs, end-user gear, etc.)

Cartoon Guide to QOS

Tampa / Honolulu Model: new dedicated road

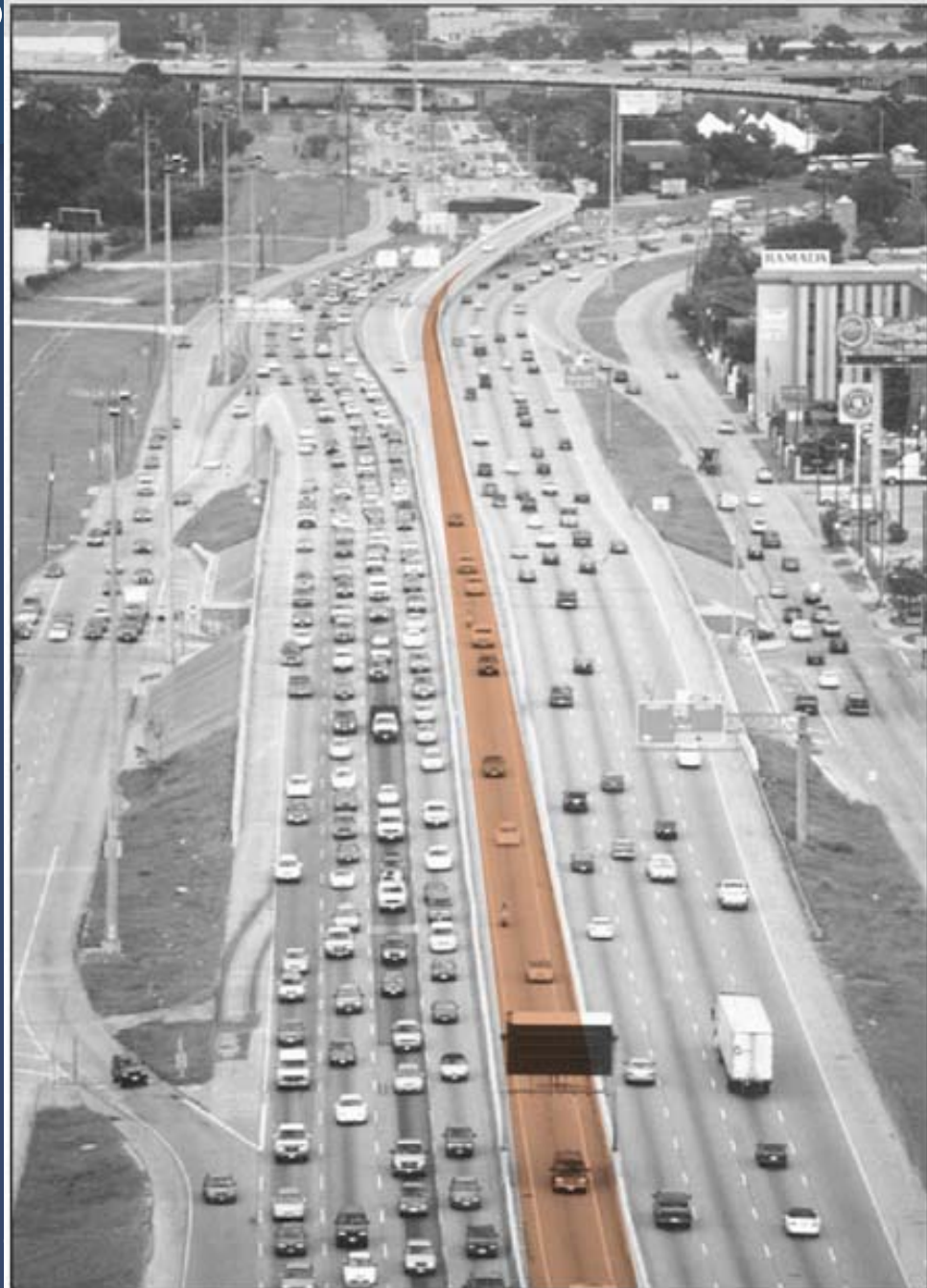
In the IP world,
each site
doesn't
get a
dedicated
bypass
to each
other site



Cartoon Guide to QOS

More Typical: Use what you've got

- This was a retrofit on existing roadway; relatively inexpensive, and effective so long as priority cars are at most %20 of total traffic



Cartoon Guide to QOS

About “resource reservation”

- QOS only comes into play during congestion.

With network QOS,
There is no queuing
when not congested

No reservation
required today!



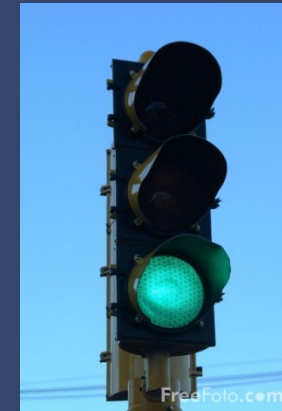
Cartoon Guide to QOS

About “resource reservation”

- Lots of policy options:

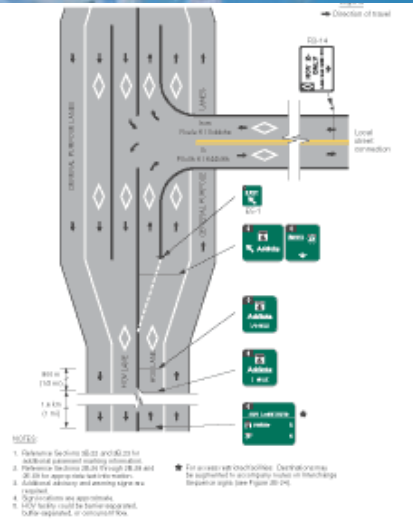


what to do is
up to you!

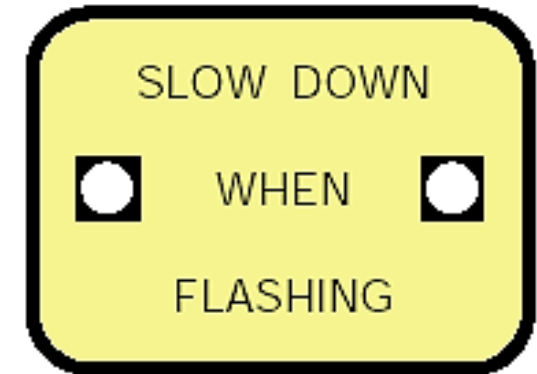


Simple buffering

or lower expectations ...



Complex
Policy Rules
(routing &
prioritization)



Cartoon Guide to QOS

Traffic Study: Waiakamilo Terminus, Honolulu



Cartoon Guide to QOS

Traffic Study: Nimitz Terminus, Honolulu



Cartoon Guide to QOS

How does the road analogy apply?

- Some prioritization choices are more invasive than others.
- Local mechanical details are important.
- When implementing Network Bandwidth Reservation (QOS), similar considerations need to be made.

Cartoon Guide to QOS

Enough about roads already

- Typically real-time (synchronous) traffic doesn't need much bandwidth, it just needs a little bit *very consistently*
- Web and Email traffic are bursty. Most of the time we sit and watch the screen while the computer waits for the human to do something. (100ms is a long time...)
- We have more to gain than to lose by implementing a reservation strategy.

Cartoon Guide to QOS

Enough about roads already: show me the applications!

Synchronous Applications:

- Voice, H323 (Video Conferencing)
one example, the “Intouch H323 robot” →
- Cisco TelePresence, HP Halo
- ISCSI (virtual disk farm)

Asynchronous:

- Radiology Images (Dicom)
- Asynchronous: Large data copy \gg 1Gb



Implementing Quality of Service Network Policy at OHSU

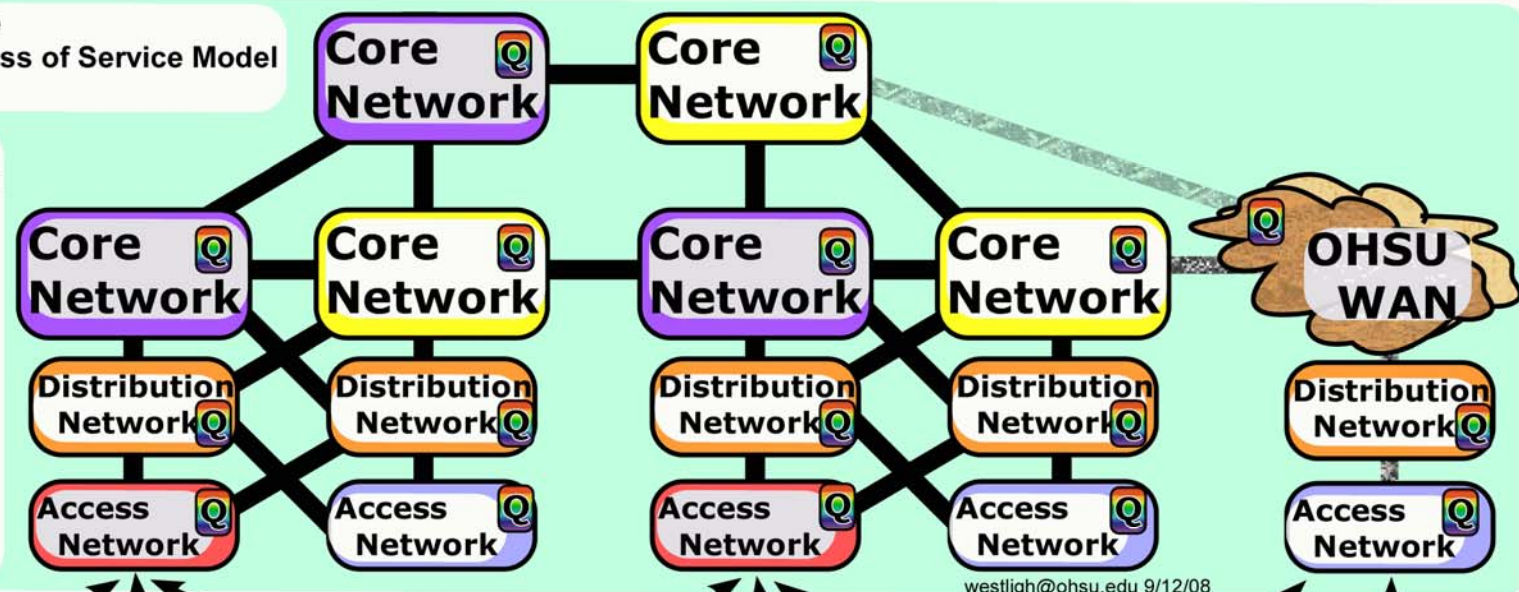
QOS Optimizes network performance across limited bandwidth for multiple applications.

Without QOS: first come first served.

Phase 1: Infrastructure
Implement General Class of Service Model
Across ~2500 devices

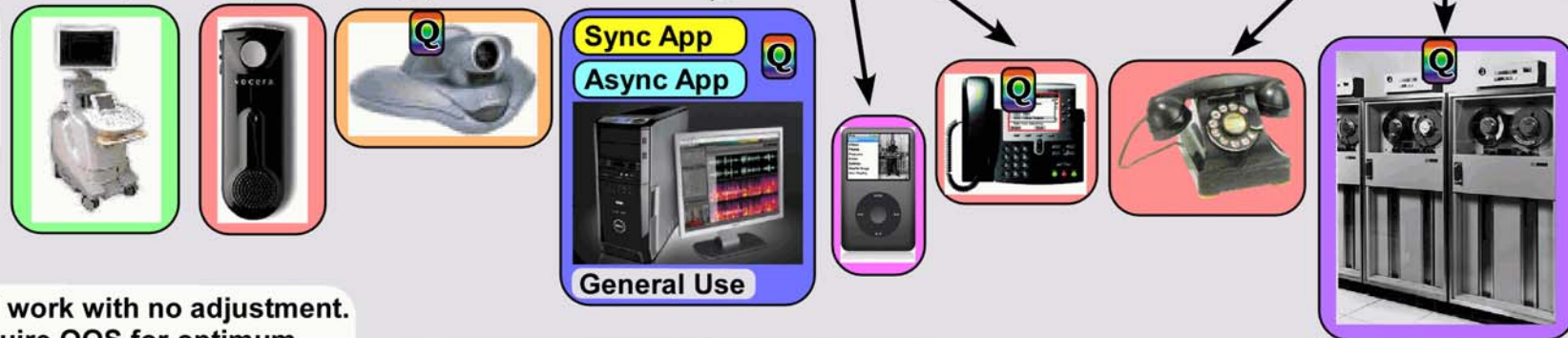
Example QOS General Class of Service Model

0.5%	Voice
1%	Conferencing
2.5%	Sync App
20%	Imaging
10%	Async App
50%	General Use
14%	Bulk Data
2%	Scavenger



QOS Policy Implementation

Application Phases:



Most apps will work with no adjustment. Some may require QOS for optimum performance. (No negative effect, just improvement when we implement.)

A few applications will degrade after phase 1, until we can implement for the specific application.

- For each relevant application we need to understand network requirements:
- * Jitter
 - * Latency
 - * Packet Drop
 - * Bandwidth
 - * IP Protocol
 - * Host/Port

Application traffic categorization can be implemented at the network port or on the host (if the host supports QOS and we trust the host to do so.)
network port change in any case...

Cartoon Guide to QOS

RFC 4594: Configuration Guidelines for DiffServ Service Classes

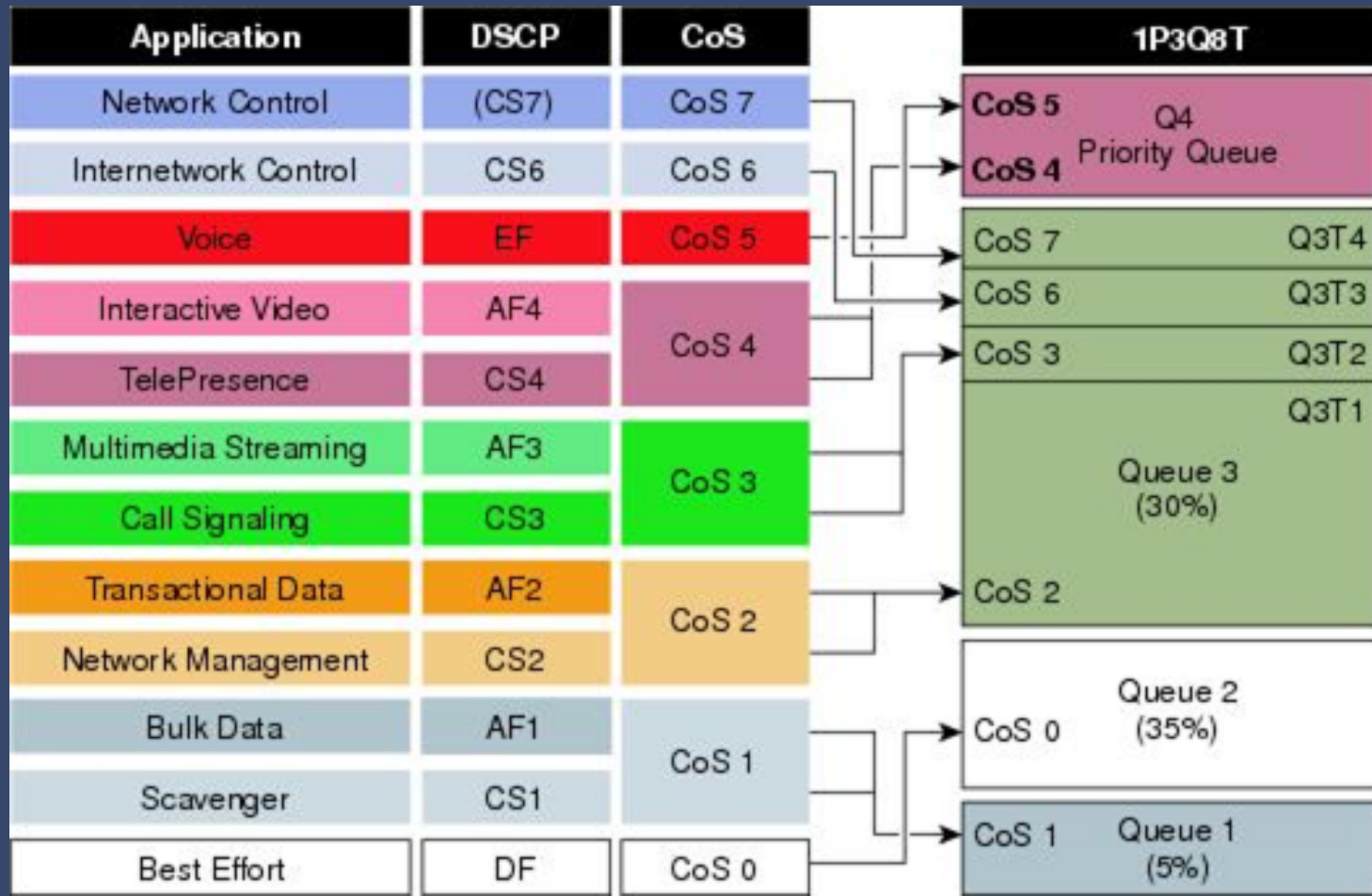
- We have an agreed framework for classifying traffic. (DiffServ RFC 4594)
- Each hardware (vendor & platform) handles QOS a bit differently.
- In practice, this means we need to map the standard DiffServ framework to whatever the local hardware can do.
- I don't care what sort of hardware you have, but so long as you mark your Voice as "DiffServ EF" and handle appropriately,

Cartoon Guide to QOS

RFC 4594: DiffServ

WRED: Weighted Random Early Detection

Application DSCP Class of Svc. WRED Threshold



Example Implementation:

Cisco Catalyst 6500

1P3Q8T
 1 – Priority Queue
 3 – Regular queues
 8 – Thresholds

Egress Queuing Recommendations

for TelePresence Deployments - Cisco systems

Network Neutrality

Control of bandwidth

- We need to prioritize network traffic such that various applications all work at the same time on the same shared networks.
- In a perfect world, one could requisition the level of service needed, and pay for it.

Network Neutrality

Control of bandwidth

- Criticism of carriers violating “net neutrality” have to do with policy preventing a standard user from fully using their contracted bandwidth.
- In a “neutral” network, you can use all the bandwidth for anything you want.

Network Neutrality

Control of bandwidth

- Many providers reserve some bandwidth off the top exclusively for particular apps.
(In this example, If you're not using the reserved application, you don't get the reserved bandwidth.)
- It is generally possible to prioritize most traffic such that the pipe can be used by lower priority bits. I.E. “Neutral”

Network Neutrality

Control of bandwidth

- Many service providers block (or severely reduce) some protocols or destinations outright.
- This can include blocking or degrading
 - Traffic deemed harmful (with a broad brush)
 - Traffic with low business value (e.g. SPAM)
 - Competition... (even say anti-communists)(It could be easy for a normal person to get swept into this black-hole)

Network Neutrality

Can the user make full advantage of bandwidth

- [slashdot.org] Posted by kdawson on Sunday August 23, @04:08PM from the deliver-what-was-paid-for dept.
- [Rik van der Kroon](#) writes "*Major Dutch cable provider UPC has introduced a new network management system which, from noon to midnight, for certain services and providers, caps users' bandwidth at 1/3rd of their nominal bandwidth (Google translation; Dutch original here). After the consumer front for cable providers in The Netherlands received many complaints about network problems and slow speeds, UPC decided to take this as an excuse to introduce their new 'network management' protocol which slows down a large amount of traffic. All protocols but HTTP are capped to 1/3 speed, and within the HTTP realm some Web sites and services that use lots of upstream bandwidth are capped as well. So far UPC is hiding behind the usual excuse: 'We are protecting all the users against the 1% of the user base who abuse our network.'*"

Network Neutrality

Can the user make full advantage of bandwidth

- [slashdot.org] Posted by kdawson on Tuesday August 25th, @05:38PM
- "The FCC chairman, Julius Genachowski, told Congress today that the 'Federal Communications Commission plans to keep the Internet free of increased user fees based on heavy Web traffic and slow downloads. ...
"There is no confusion ...that this FCC will support net neutrality and will enforce any violation of net neutrality principles," The commission remains locked in litigation with Comcast. The cable provider is appealing a court decision by challenging the FCC's authority to penalize the company for limiting Web traffic to its consumers."

Network Neutrality

FCC

<http://openinternet.gov/read-speech.html>

- Network operators cannot prevent users from accessing the lawful Internet content, applications, and services of their choice
- Nor can they prohibit users from attaching non-harmful devices to the network.
- Non-discrimination -- broadband providers cannot discriminate against particular Internet content or applications.
- Transparency -- providers of broadband Internet access must be transparent about their network management practices.

Network Neutrality

Control of bandwidth

- Bottom line: When implementing a bandwidth reservation strategy, “network neutrality” should be considered, and the carrier should be clear with the customer regarding conditions affecting contracted data service.
- FYI: NWAX is neutral. OHSU is not.

Managing Network Bandwidth Reservation

So how do we implement and manage QOS?

- 1) Pick ~2 applications (which could benefit)
- 2) Develop queuing policy (DSCP map)
- 3) Turn on QOS in network hardware
- 4) Mark the traffic at the edge
- 5) Develop measurement & monitoring
- 6) Test in lab
- 7) Implement / Go-live
- 8) Validate Production

Managing Network Bandwidth Reservation

Example: a Cisco WAN router QoS in software, can police, shape, and manage congestion, NBAR classification available

```
Extended IP access list phone-signaling
```

```
10 permit tcp any any eq 1720 (1443 matches)
```

```
20 permit tcp any any eq 1039 any (477 matches)
```

```
30 deny ip any any (14508713 matches)
```

```
Extended IP access list ClinicB99
```

```
10 permit ip any 10.72.4.0 0.0.3.255 (400276438  
matches)
```

```
20 permit ip any 137.53.40.0 0.0.0.255 (37633856  
matches)
```

```
30 deny ip any any (3036130314 matches)
```

```
class-map match-all BHC-other
```

```
match access-group name ClinicB99
```

```
class-map match-all BULK-DATA
```

```
match access-group 57
```

```
class-map match-any VOICEorSIGNALING
```

```
match dscp ef
```

```
match dscp cs5
```

```
match access-group name phone-signaling
```

```
match protocol rtp audio
```

```
match protocol rtcp
```

```
class-map match-all BHC-VOICEorSIGNALING
```

```
match access-group name ClinicB99
```

```
match class-map VOICEorSIGNALING
```

```
class-map match-all BHC-InteractiveVideo
```

```
match access-group name ClinicB99
```

```
match dscp af41
```

```
policy-map METRO-OUTBOUND
```

```
class BHC-VOICEorSIGNALING
```

```
priority 1920
```

```
class BHC-InteractiveVideo
```

```
priority 500
```

```
set dscp cs5
```

```
class BHC-other
```

```
shape average 30000000 300032
```

```
class class-default
```

```
fair-queue
```

```
interface GigabitEthernet0/0
```

```
description METRO 99.NNNN.12345..ABCD
```

```
bandwidth 100000
```

```
ip address 10.6.0.1 255.255.255.0
```

```
ip access-group smtp-block out
```

```
ip nbar protocol-discovery
```

```
ip route-cache flow
```

```
no ip mroute-cache
```

```
delay 20
```

```
duplex auto
```

```
speed auto
```

```
media-type sfp
```

```
service-policy output METRO-OUTBOUND
```

Cartoon Guide to QOS

Questions:



Thank you

Don Westlight westligh@ohsu.edu 503.418.1081

Manager, Network Architecture & Engineering, ohsu.edu

Director, nwax.net

Technology Chair, Oregon Health Network oregonhealthnet.org

