What is Bufferbloat?

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SLOW INTERNET CONNECTION!
THEY THOUGHT OF EVERYTHING!
Solving Plumbing problems

- Discovery
- Blame
- Enlightenment
- Nirvana
Bufferbloat: definition
Queuing Theory Basics

\[
\text{average time in queue} = \frac{\text{utilization}}{\text{service rate}} \cdot \frac{1}{1 - \text{utilization}}
\]

From Fred Baker: Bufferbloat!

Graphic courtesy Sprint, Apricot 2004
How bad is it?

150ms – VOIP
20ms – Desktop lag
100ms – DNS lookup fail
ARP, ND – Can't find machine
1000ms – User's give up
scp copy fails
DHCP – Machine falls off network
Triggers

- **Uploads**
  - Youtube
  - Dropbox
  - Torrent
  - Large Email attachments
  - Backup services

- **Downloads**
  - Movie downloads
  - Image heavy websites
  - Video teleconferencing
Netalyzr: Upstream
Gettys J.,
Bufferbloat: "Dark" Buffers in the Internet
BUFFER BLOAT

IS KILLING MY TCP STREAM
Classical TCP

- Slow-start: exponential increase of cwnd
- Congestion avoidance: linear increase of cwnd

Diagram shows the timeline of Cwnd with timer expiration and threshold points.
TCP congestion window (cwnd) timeseries

SCALE IIx 23 Feb 2013
TCP throughput dynamics

\[
\text{mean throughput} = \frac{\text{effective window}}{\text{mean round trip time}}
\]

From Fred Baker: Bufferbloat!
Blame Linux

Windows XP
- Maximum window 64k

Windows 7
- Bandwidth limit to 80 mbits

Android
- Receive window limited
Blame the customer

- Customers call support
- Applications are using more bandwidth
- Block and charge

![Image of two people pointing to the words "bittorent" and "skype"]
Stand back!

Iz goin to do science!
Back to Reality
Benchmark issues

- Bad
  - Bytes/sec
  - Packets/sec
  - Latency
Making a good test

- Combinations
  - RRUL
FIFO – the default

Ping 1sec!

Upload

Download
Stochastic Fair Queue

Høiland-Jørgensen T., Battling Bufferbloat
Controlled Delay - codel
Fair Queue Controlled Delay
Fight Bufferbloat
Linux Everywhere

In the Datacenter

If we fix Bufferbloat, the world will change... eventually

SCALE 11x 23 Feb 2013
The ICSI Netalyzr

**Network Access Link Properties**

- **Network performance (?):** Latency: 220 ms, Loss: 0.0%
- **TCP connection setup latency (?):** 229 ms
- **Background measurement of network health (?):** no transient outages
- **Network bandwidth (?):** Upload 3.8 Mbit/s, Download 250 Kbit/s

**Your Uplink:** We measured your uplink’s sending bandwidth at 3.8 Mbit/s. This level of bandwidth works well for many users.

**Your Downlink:** We measured your downlink’s receiving bandwidth at 250 Kbit/s. This rate could be considered quite slow, and will affect your user experience if you perform large transfers.

**Network buffer measurements (?):** Uplink is good, Downlink 490 ms

We were not able to produce enough traffic to load the uplink buffer, or the uplink buffer is particularly small. You probably have excellent behavior when uploading files and attempting to do other tasks.

We estimate your downlink as having 490 ms of buffering. This level can in some situations prove somewhat high, and you may experience degraded performance when performing interactive tasks such as web surfing while simultaneously conducting large downloads. Real time applications, such as games or audio chat, may also work poorly when conducting large downloads at the same time.
Bufferbloat project

• Information
  – Research
  – Presentations
  – Mailing lists
**Quality of Service**

With QoS you can prioritize network traffic selected by addresses, ports or services.

**Interfaces**

**GE00**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>✔️</td>
</tr>
<tr>
<td>Classification group</td>
<td>default</td>
</tr>
<tr>
<td>Calculate overhead</td>
<td></td>
</tr>
<tr>
<td>Half-duplex</td>
<td></td>
</tr>
<tr>
<td>Download speed (kbit/s)</td>
<td>3000</td>
</tr>
<tr>
<td>Upload speed (kbit/s)</td>
<td>750</td>
</tr>
</tbody>
</table>

1. Uncheck "Enable" to turn off QoS
2. Use http://speedtest.net
3. Enter Download and Upload speeds
4. Check "Enable" to turn QoS back on
5. Click Save & Apply

**Classification Rules**

<table>
<thead>
<tr>
<th>Target</th>
<th>Source host</th>
<th>Destination host</th>
<th>Service</th>
<th>Protocol</th>
<th>Ports</th>
<th>Number of bytes</th>
<th>Sort</th>
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<tbody>
<tr>
<td>pri</td>
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<td>all</td>
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<td>TCP</td>
<td>22,222,53</td>
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<td>all</td>
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<td>53,123,5060,5190</td>
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<tr>
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<td>all</td>
<td>873</td>
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<td></td>
</tr>
</tbody>
</table>

**Add**
Future Research

- Systemic view
- Change Linux default?
- Wireless
- High speed 10/40/100G?
Thank you

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