

# **Responsiveness under Working Conditions**

**draft-cpaasch-ippm-responsiveness**

**C. Paasch, R. Meyer, S. Cheshire, O. Shapira**

# Why ?

## Problem #1

- 10+ years of Bufferbloat
- Still very widespread
- Need to raise awareness & tools
  - End-user as forcing-function
  - Forcing-function creates market incentive
  - Easy usable tools to measure *"bufferbloat"*

## Problem #2

- What is *"bufferbloat"*
- ICMP-ping, UDP-ping, TCP request/response, H3 ?
- How to "load" the network ?
- Huge differences in existing tools
  - DSLReports, Fast.com, waveform,...
- Need for a standardized metric of *"Responsiveness under working conditions"*

# Responsiveness for the end-user

- "Bufferbloat" may happen anywhere between client and server application



- Use modern protocols (HTTP/2, HTTP/3, TLS, ...)
- Measure all stages of the connections (DNS, TCP-handshake, TLS, ...)
- User-friendliness

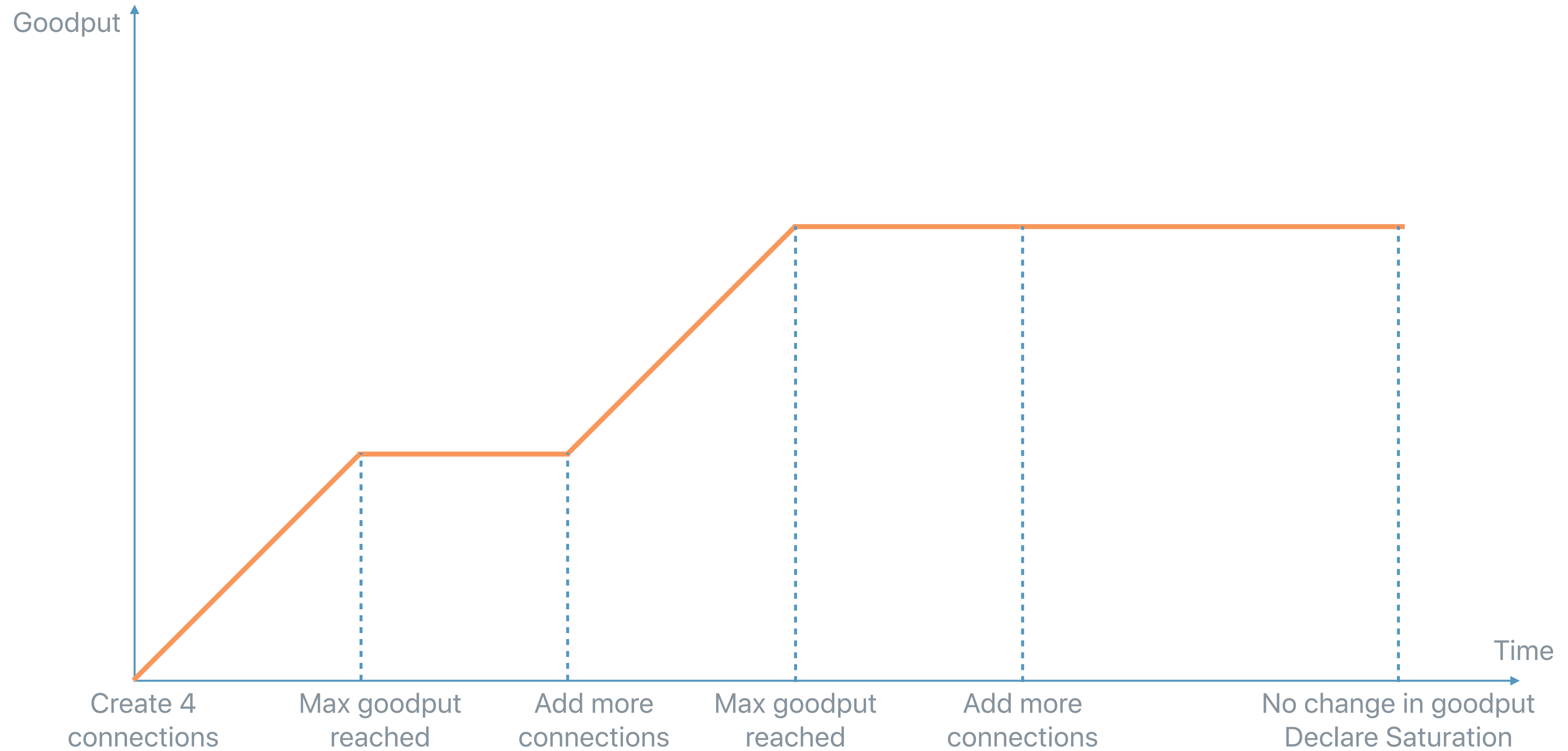
# Working conditions

Need to fill buffers to measure responsiveness



- Use “realistic” traffic patterns
  - HTTP/2 bulk-data transfer
- Need to create full working conditions for extended period of time
  - Gradually add flows and monitor goodput evolution

# Stable “working conditions”



# Measuring Responsiveness

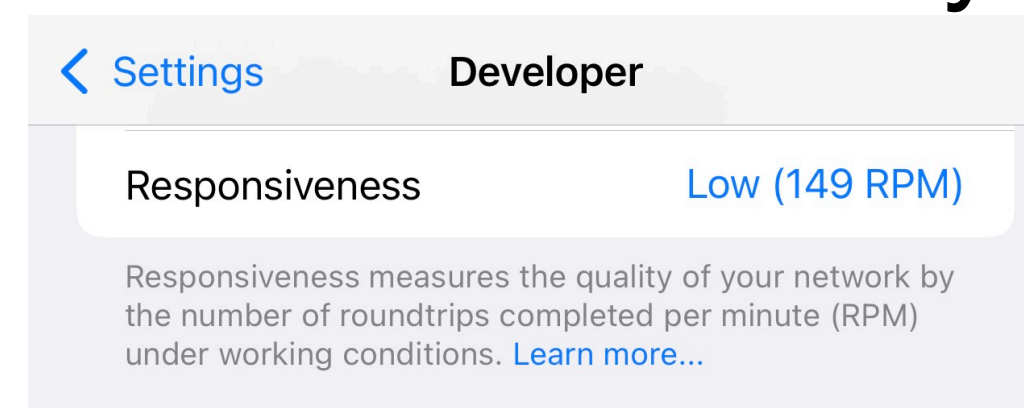
- HTTP/2 GET request on load-bearing connections
  - Exposes bad HTTP/2 & TCP implementations
  - Exposes bad buffering in the network
- Separate short-lived parallel HTTP/2 GET requests
  - Allows to measure DNS/TCP/TLS/GET requests
  - Exposes flow-queueing in the network
- Aggregating latency measurements into single number
  - Average? 75th percentile?

# Responsiveness Metric & Tool

- Round-trips per Minute (RPM)
  - Higher is better
  - Integer range from low tens (> 1 second of latency) to a few thousand (less than 50 ms of latency)
  - Nice analogy to car engine's "revolutions per minute"

• `/usr/bin/networkQuality` in macOS Monterey

• Responsiveness UI in iOS 15



```
$ networkQuality
==== SUMMARY ====
Upload capacity: 191.175 Mbps
Download capacity: 275.957 Mbps
Upload flows: 20
Download flows: 12
Responsiveness: High (3047 RPM)
```

# **Responsiveness under Working Conditions**

**draft-cpaasch-ippm-responsiveness**

Please contribute at:

<https://github.com/network-quality/draft-cpaasch-ippm-responsiveness>