Should You Care about Spikes & Bursts ?!

Real World Example of Identifying Spiky Behavior of IPTV Encoder

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Measuring, Analyzing, and Visualizing Spikes/Bursts

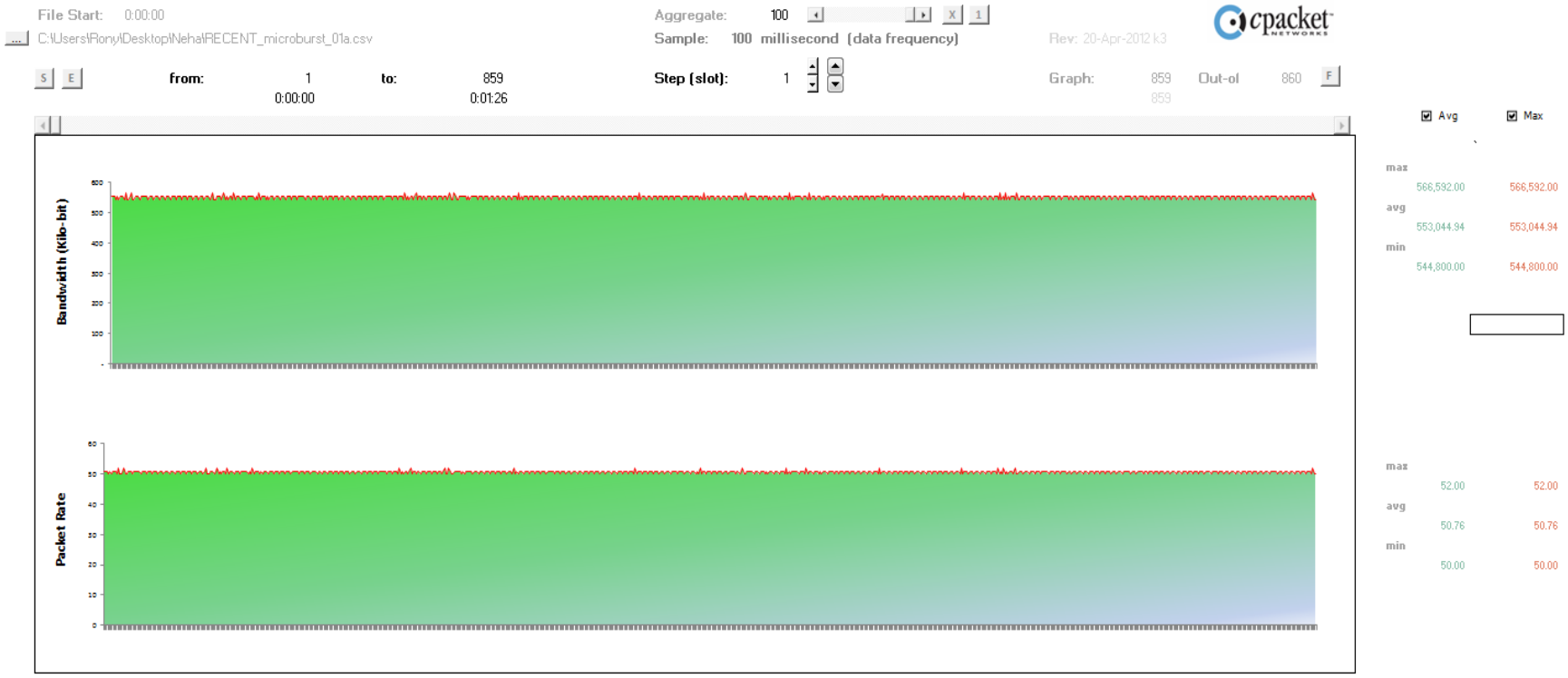
- Spikes and bursts are often the root-cause for problems in datacenters, media apps, gaming, high frequency trading, …
- Measurement of bandwidth over one second is not granular enough to detect a millisecond bursts which may violate capacity constraints resulting in packet loss
- Uniquely, cPacket smart ports measure traffic on-the-fly at a user-defined interval (*e.g.* 1,000 times per second) which enable detection of millisecond bursts
- This document provides real life example of using cPacket's cVu product to transparently measure and analyze encoded IPTV traffic at millisecond granularity

IPTV Measurement Results at Varied Intervals

	100 millisecond Interval	10 millisecond Interval	1 millisecond interval
Average per Interval	553,045 bits/100ms	55,305 bits/10ms	**5,530 bits/ms**
Maximum per Interval	566,592 bits/100ms	56,901 bits/10ms	**65,376 bits/ms**
Ratio Maximum to Average	~1.02 X	~1.03 X	**~11.82 X**

- At 100 millisecond or 10 millisecond measurement intervals, the ratio between the average and Maximum bandwidth - per interval - is close to one (within a few %)
- However, at 1 millisecond interval the ratio between the average and maximum is over **10X**
- **Conclusion: for a short duration of a few milliseconds the traffic spiked from 5.53Mbps to 65.37Mbps and violated the capacity constraints by more than 10X**

Overview of 86 seconds of Encoded IPTV Stream

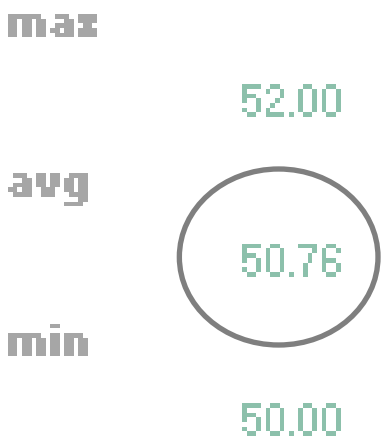


- At measurement frequency of 10 times per second (*i.e.* intervals of **100 milliseconds**) the traffic seems to be stable

Stats: 86 seconds at 100 ms Intervals

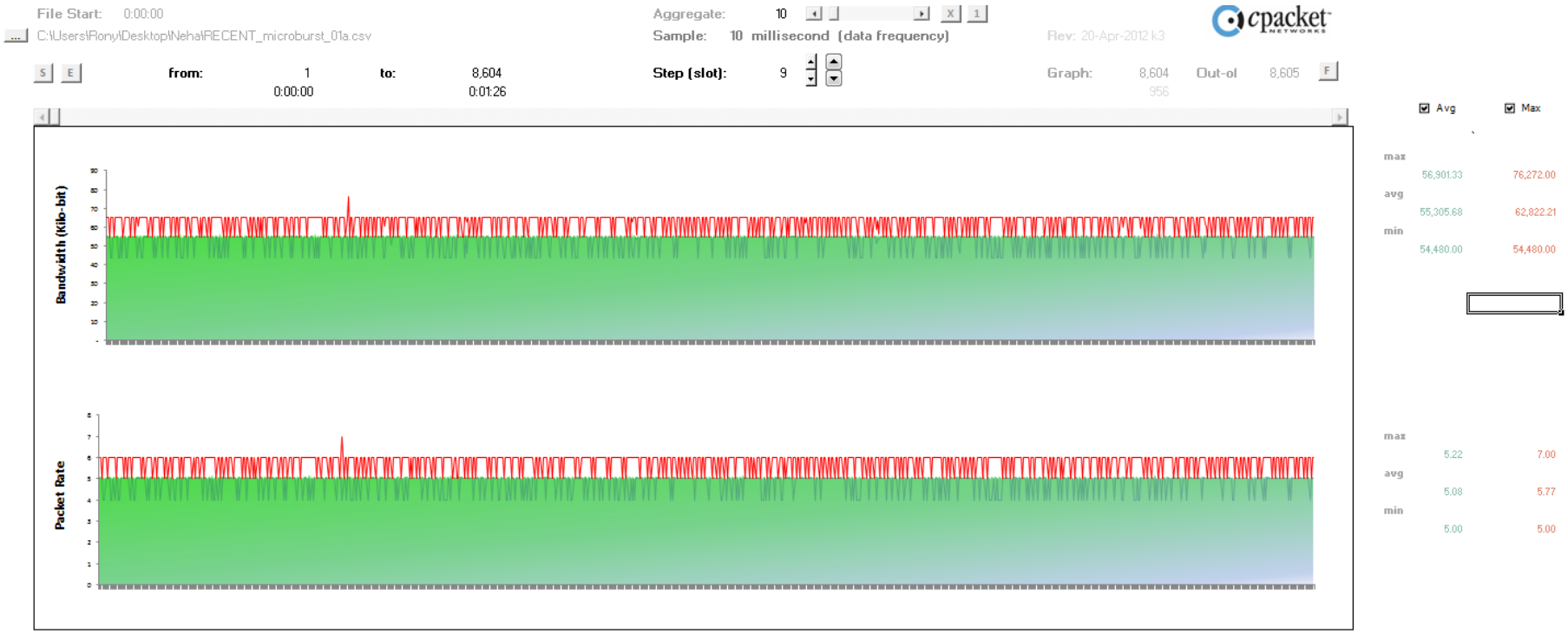
Bit Rate per 100 milliseconds

Packet Rate per 100 milliseconds



- The bit rate (bandwidth) is stable - it varies from 554,800 to 566,592 bits per 100 milliseconds (*i.e.* ~5.54 to ~5.66 Mbps)
- Average number of packets per interval of 100 milliseconds is **50.76** (*i.e.* ~507.6 per second)

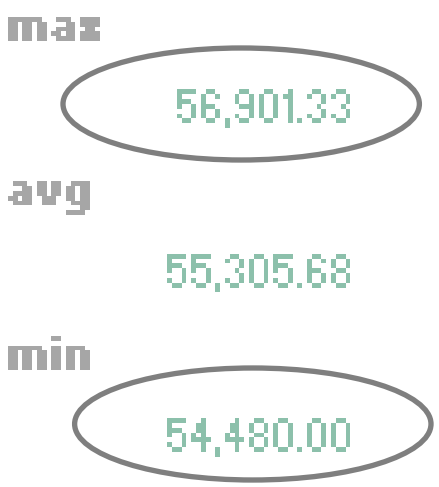
Overview of 86 seconds at 10 ms Intervals



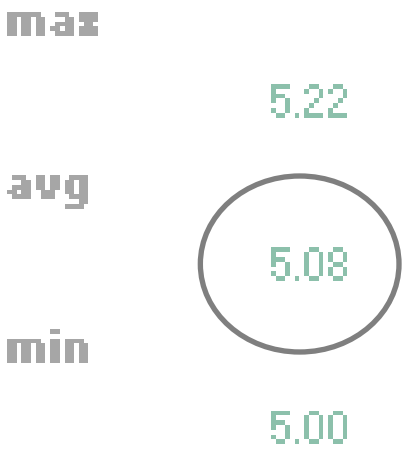
- At measurement frequency of 100 times per second (*i.e.* intervals of **10 milliseconds**) the traffic still seems to be stable
- It shows only variation of one-two packets between the intervals

Stats: 86 seconds at 10 ms Intervals

Bit Rate per 10 milliseconds

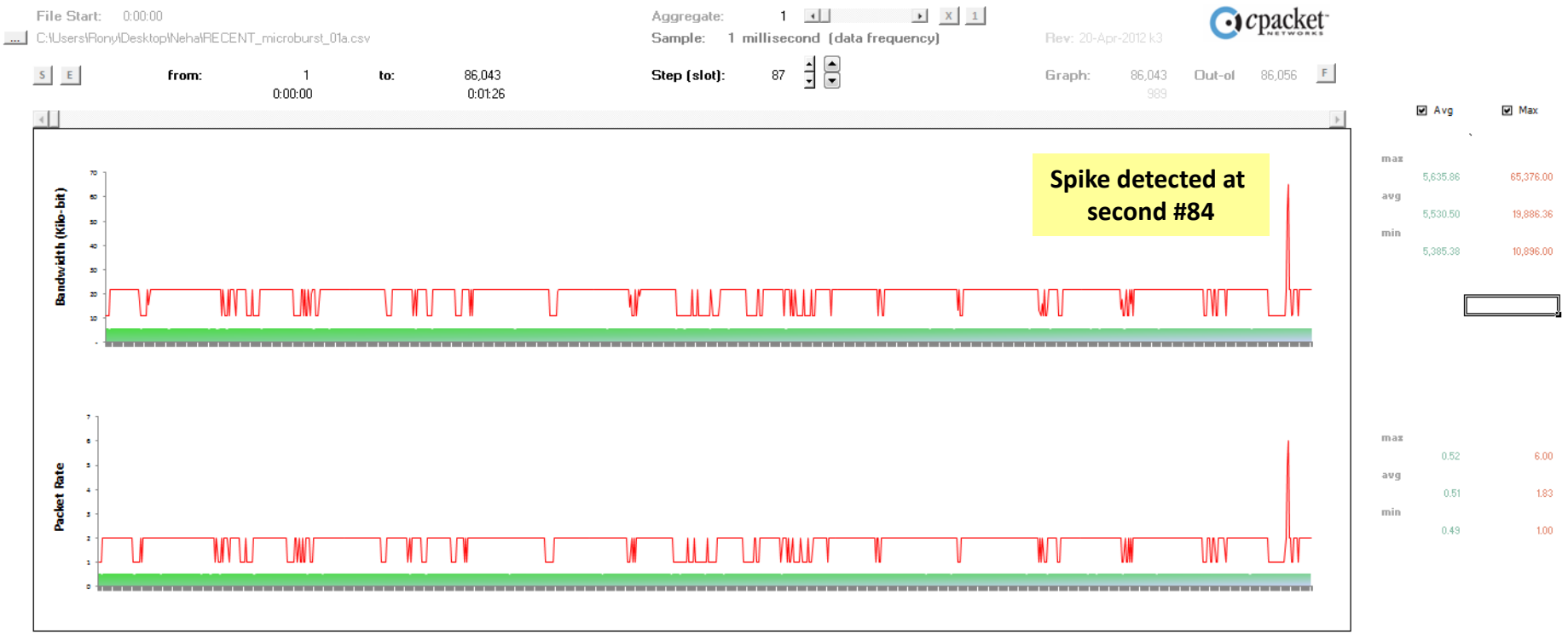


Packet Rate per 10 milliseconds



- The bit rate (bandwidth) varies from 54,480 to 56,901 bits per 10 milliseconds (*i.e.* ~5.44 to ~5.69 Mbps)
- Average number of packets per interval of 10 milliseconds is **5.08** (*i.e.* ~508 per second)

Overview of 86 seconds at 1 ms Intervals

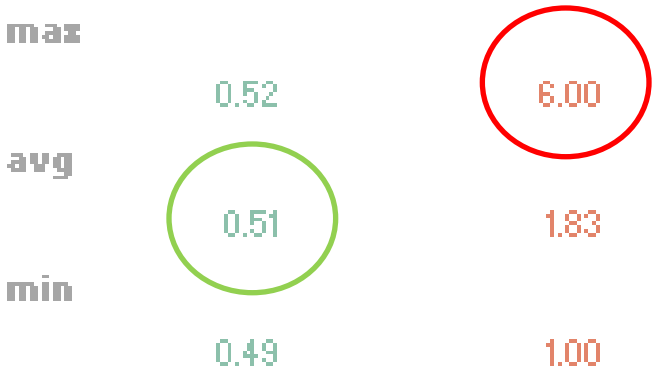


- At measurement frequency of 1,000 times per second (*i.e.* intervals of **1 millisecond**) the traffic is **"SPIKY"**
- The **red line** shows the performance **envelope** per 1 millisecond over duration of 86 seconds (1:26 minutes)

Stats: 86 seconds at 1 ms Intervals

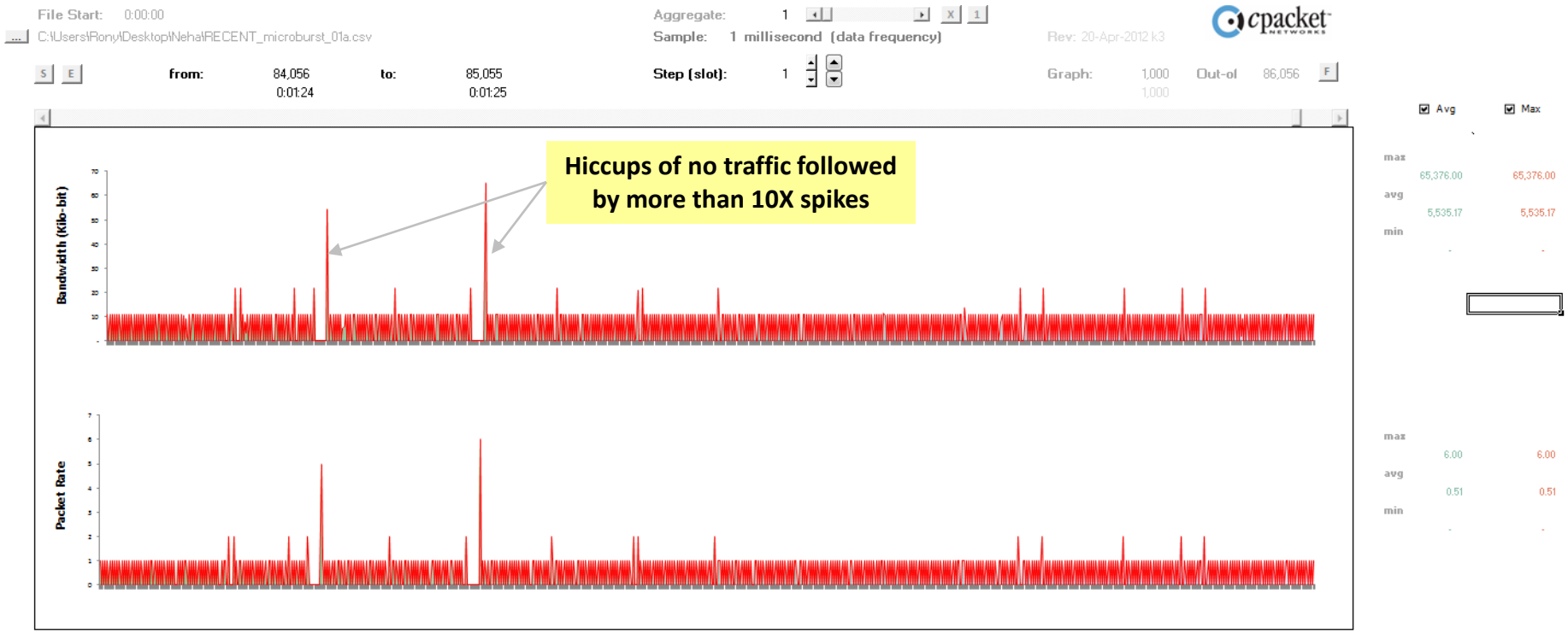
Bit Rate per 1 millisecond

Packet Rate per 1 millisecond



- The average bit rate is 5,530 bits per millisecond (*i.e.* ~5.53 Mbps), but the range is from Min of 0 to Max of **65,376** bits/millisecond (i.e. ~65.38 Mbps - over **10X** of average)
- Average number of packets per interval of 1 milliseconds is **0.51** (*i.e.* ~510 per second) but the range is from 0 to **6**

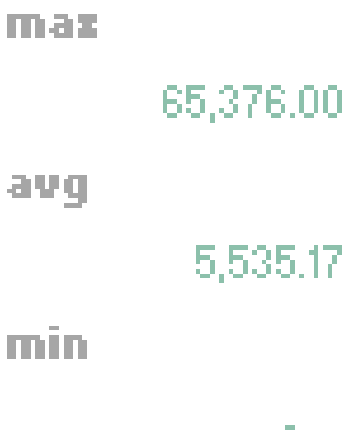
Zooming into the SPIKES at Second #84 (1:24-1:25)



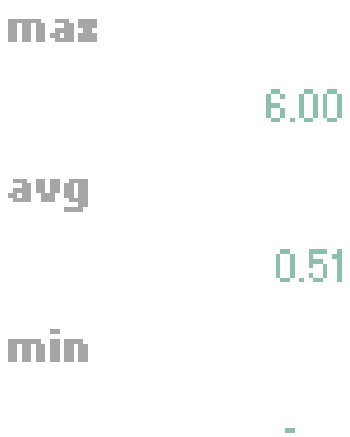
- Zooming-in reveals spikes of more than 10X magnitude above average
- Traffic stopped for ~10 milliseconds period (hiccup) and the encoder maintains the average rate by compensating with a **burst** of over **10X**

Stats: One Second (#84) at Millisecond Interval

Bit Rate per 1 millisecond



Packet Rate per 1 millisecond



- The bit rate (bandwidth) varies from average of 5,537 to maximum of 65,376 bits per 1 milliseconds (*i.e.* ~5.54 to ~65.38 Mbps),
- Average number of packets per 1 millisecond intrvals is **0.51** (*i.e.* ~510 per second) , the minimum is 0 and the maximum is 6
- The SPIKES are **over 10X above** the specified capacity constraints

Observations

- Monitoring average rate hides the SPIKES and BURSTS
  - Measurements at one second, or 100 milliseconds, or 10 milliseconds do not reveal critical issues that impact users' experience negatively
- Real life example of IPTV encoder showed unintended SPIKES that exceed the capacity planning constraints by more than 10X
  - To maintain the average rate, the IPTV encoder compensated for a "transmit **hiccup**" by bursting at over 10X
  - Spikes of multiple streams can coincide to cause even larger problems
- SPIKES and BURSTS can cause packet loss for any traffic sharing a common network infrastructure

Summary

- Spikes and bursts are common root-cause for problems in data-centers, multi-media apps, interactive gaming, high frequency trading, network storage, etc.
  - Spiky behavior can be intermittent and hard to detect and analyze
- cPacket's cVu traffic monitoring switches and cTap probes provide granular real-time performance measurement, spike detection, and visualization
  - Measurement interval is user configurable according to the needed granularity
- Identifying bursts allows Telcos to optimize IPTV infrastructure and engineer the traffic to match capacity constraints, optimize performance, and improve users' quality of experience