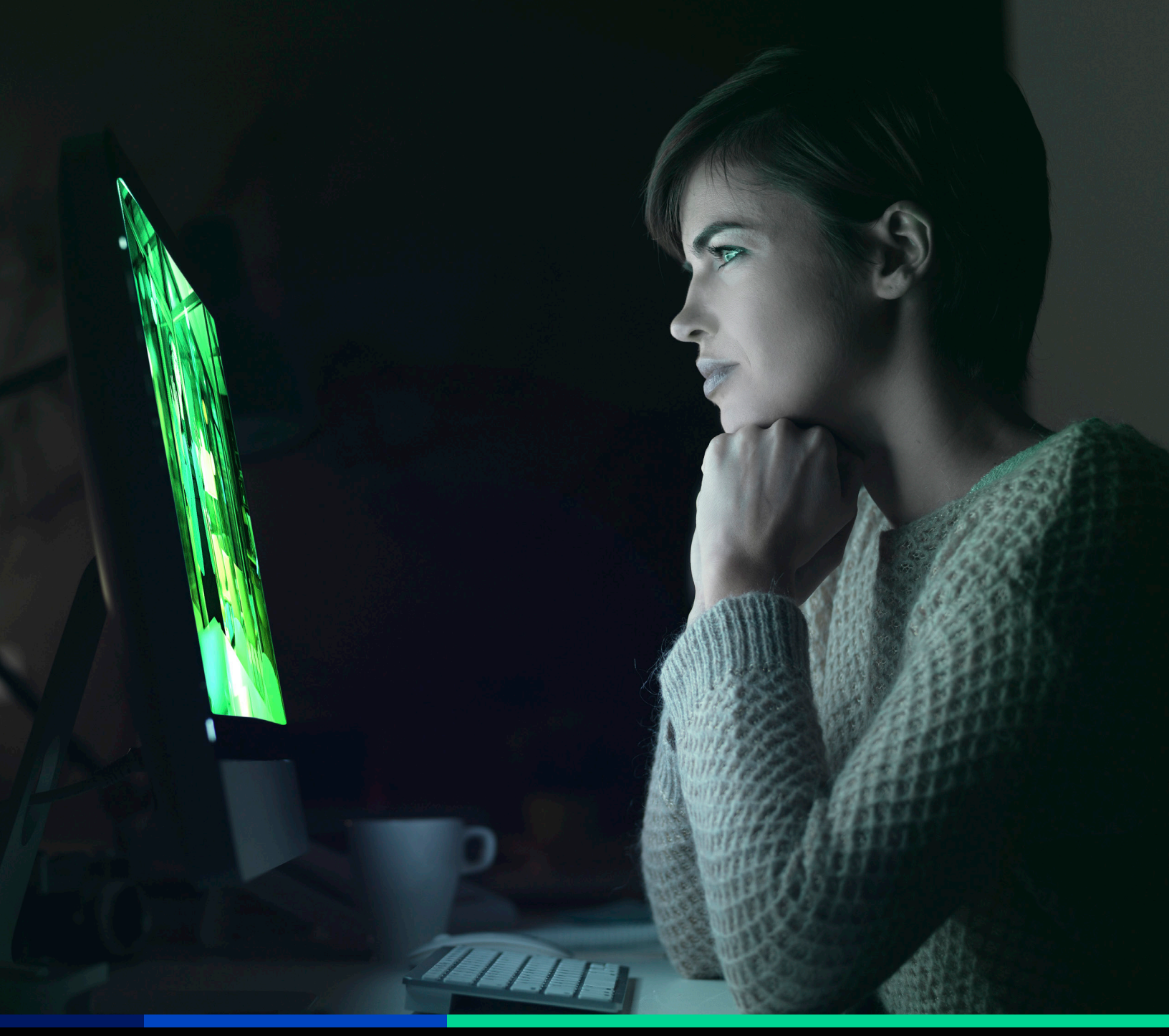


# CenturyLink® CDN Mesh Delivery

## For businesses that demand scalable and reliable video delivery

Powering next-generation video delivery

CenturyLink®

# Overview

CenturyLink CDN Mesh Delivery is an advanced implementation of the WebRTC standard that enables delivery of live and video on-demand (VOD) content across a meshed topology from a CDN and between end user devices.

Dynamic multi-sourcing determines the fastest and most efficient delivery source: either from the CDN or a mesh network of devices. By intelligently multisourcing content delivery, CenturyLink CDN Mesh Delivery offers an extra layer of flexibility, scalability and resiliency on top of a CDN architecture.

This distributed approach to delivery allows platforms to scale naturally to audiences of practically any size, virtually anywhere, regardless of the server infrastructure present. CenturyLink CDN Mesh Delivery also allows live and VOD broadcasters to improve video quality, scale in a cost-effective manner and future-proof their platforms from growing demand.

Tier 1 broadcasters today leverage this technology for their live streams, catch-up TV, user generated content, as well as their ad or subscription-based VOD content.

CenturyLink CDN Mesh Delivery customizes delivery to every device by leveraging user location, internet service provider, network topology, device, type of content and bitrate profiles to determine the fastest and most efficient delivery source.

# Benefits

**Hybrid delivery (CDN + mesh deliveries):** CenturyLink CDN Mesh Delivery combines the best of a controlled global content delivery network with the scalability of distributed mesh architecture that delivers consistently smooth and reliable on-demand video and streaming linear channels.

**Cross-platform compatibility:** Available on major web and mobile platforms, Android and iOS set top boxes, as well as smart TVs (FireTV, tvOS).

**Easy integration:** Easy plug-and-play integration with a broad range of HTML5 and mobile players with support on major web and mobile platforms.

**Visibility:** A feature-rich dashboard provides engineering teams with a comprehensive view of their platform's traffic.

**Quality of service:** By obtaining video segments from the source that can provide them most quickly, CenturyLink CDN Mesh Delivery reduces round trip time and promotes more efficient use of the infrastructure. Platforms using CenturyLink CDN Mesh Delivery see higher average bitrates and enjoy up to three times less rebuffering than with traditional CDN solutions.*

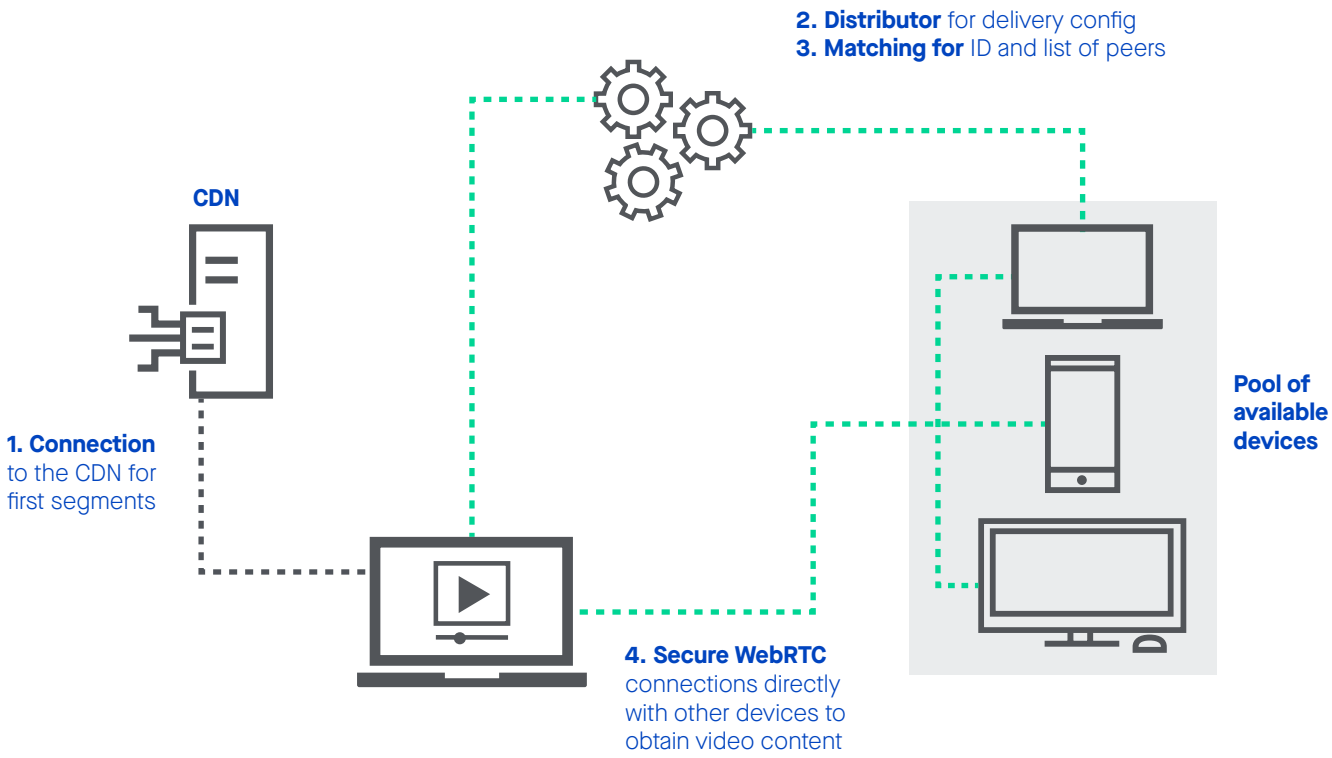
**Traffic and user scalability:** Handle traffic spikes with ease through a solution that scales naturally to viewers. More devices mean a more powerful network, increasing your delivery capacity and video quality in a cost-effective manner.

**Geographic scalability:** Extend reach to audiences all over the world, regardless of the proximity to the CDN through our high capacity, high-speed distributed content delivery network and peer-to-peer.

*Streamroot customer data February 2019

# Technology

1. On starting the video, the end user starts fetching the first video segments from the CDN.
2. The client module connects to the distributor service that authenticates the user and returns a specific configuration which has been fine-tuned to maximize QoS and efficiency.
3. The client module connects to the matching service that assigns the viewer a unique ID. The device periodically requests tracks and peers throughout the session and the matching service provides an updated list of devices with which the peer should connect.
4. The client module connects to other devices watching the same content at the same time via the signaling service using a WebRTC connection. All WebRTC connections are fully secured via DTLS.




Once connected, individual device limitations are accounted for so device performance and data consumption are not burdened. A minimum buffer threshold is set for end users so that if the buffer falls below the threshold, the CenturyLink CDN Mesh Delivery client will instantly and seamlessly fall back to CDN delivery.

# Capabilities

| Description | Details |
|---|---|
| Platform compatibility | Web browsers (Chrome, Firefox, Safari, Opera, Chromium-based browsers), iOS, Android, Android TV, iOS, tvOS, FireTV, all Android-based STBs (FireTV, etc.), Chromium-based STBs, Chromecast, Samsung TVs (Tizen 3.0+), LG TVs (WebOS 3+) |
| Player compatibility | hls.js, dash.js, video.js, Skaka Player, Flowplayer, Clappr, JW Player, THEOPlayer, Bitmovin Player, RadiantMP, Castlabs, Brightcove Player, Azure Media Player, thePlatform MPX Player, AMP, Kaltura Player, ExoPlayer, NexPlayer, AVPlayer |
| Custom players | • Can integrate with custom HTML5 players upon request<br>• Can integrate with custom Android & iOS-based players upon request |
| Media format support | • HTTP Streaming formats supports: DASH, HLS, Smooth Streaming<br>• Supports both live and VOD streaming, without adding any latency for live<br>• CMAF support<br>• Support for multi-bitrate streams |
| Media features | • DRMs, tokens, geo-blocking & authentication mechanisms supported<br>• SSAI providers support: Amazon Media Tailor, Yospace, AdInsertion Platform<br>• Supports all common media features like subtitles, multi-audio, DVR, fallback URLs, etc. |
| Security features | • Mesh network cryptographic integrity checks<br>• Domain whitelisting<br>• App secret key whitelisting<br>• Fully encrypted communications with the backend (HTTPS & WSS)<br>• DNA backend authentication and matching features<br>• Fully encrypted DTLS mesh network communications |
| DNA dashboard - Web GUI to monitor and control | • Monitor DNA vs CDN traffic in volume and throughput<br>• See number of concurrent users over time<br>• See details per stream and per platform<br>• QoS data: buffering ratio over time |
| Data API | • Basic Data API:<br>  • DNA & CDN traffic over time<br>  • Concurrent viewers over time<br>  • Buffering ratio over time<br>  • Top 100 streams in traffic, bandwidth and audience |
| Advanced data analysis | • Advanced Insights API (to be released in December) allowing multi-dimensional queries including:<br>  • Platform<br>  • Live & VOD<br>  • Stream<br>  • SiteId<br>  • Country<br>  • ISP<br>• Custom Efficiency Reports per customer upon request (paid service), accessing and compiling data from our Hadoop data pipeline |

| | |
|---|---|
| Dashboard real-time monitoring | • Real-time monitoring panel showing top streams with DNA vs. CDN efficiency and audience |
| Alerting and reporting | • Automatic reporting interface that can send daily, weekly and monthly reports on efficiency and traffic<br>• On-demand alerting service from our customer support if we detect anything unusual in different metrics: efficiency, audience, QoS, new release, etc. |
| Dashboard configuration | • Create properties to use different configuration options for different types of content (live vs. VoD, premium vs. free, etc.)<br>  • SSAI detection<br>  • Range request detection<br>  • Wifi and cellular network upload and download configuration<br>  • Activation Ratio feature for easy ramp-up and full control over the mesh network<br>  • Activation threshold for VOD: activate the DNA plugin only on the most popular streams with more than 3 active users in the last 20 minutes |
| Client-side configuration and API | • Configuration: ContentId, asynchronous loading, siteId for DNA Enterprise<br>• Client API:<br>  • Per-user traffic data<br>  • Upload and download control API per network type |
| Client-side optimization features | • UDP-based delivery, better resource utilization than for HTTP/TCP<br>• 100% transparent for end-users: nothing to install<br>• In-segment multisourcing: pre-fetching each segment from several peers at the same time<br>• Adaptive Device Resource Usage: our module constantly monitors core health metrics on the device (CPU, memory, QoS, battery, etc.) to adapt the efficiency algorithms to the capabilities of the device in real time<br>• Advanced congestion control algorithms<br>• Protection against uplink saturation<br>• Pre-buffering from other peers<br>• Dynamic buffer level configuration (patented) |
| Matching features | • Smart matching via machine learning by network topology, ISP, region, city, etc.<br>• Can restrict matching between specific ISPs or inside specific ISPs |
| SLA | • 99.99% uptime<br>• Instant and seamless fallback to CDN in case of any issues<br>• Multi-region backend for better resilience and high availability<br>• Can overcome short CDN downtimes by offloading delivery to the peer network |

# Metrics

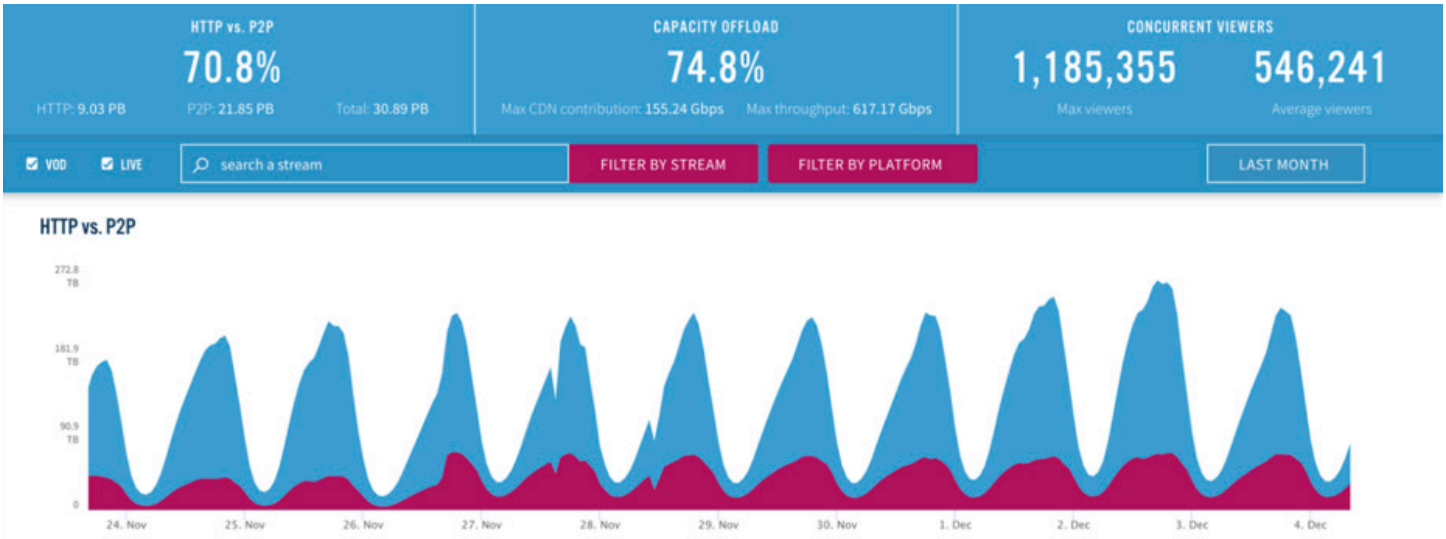



**Figure 1: Traffic from a European VOD platform in November 2018**

This VOD platform delivers popular series and catch-up TV in several European countries. Delivery to average audiences of over 500,000 viewers and spikes every evening upward of 1 million. The peer-to-peer technology helps this customer scale its infrastructure.

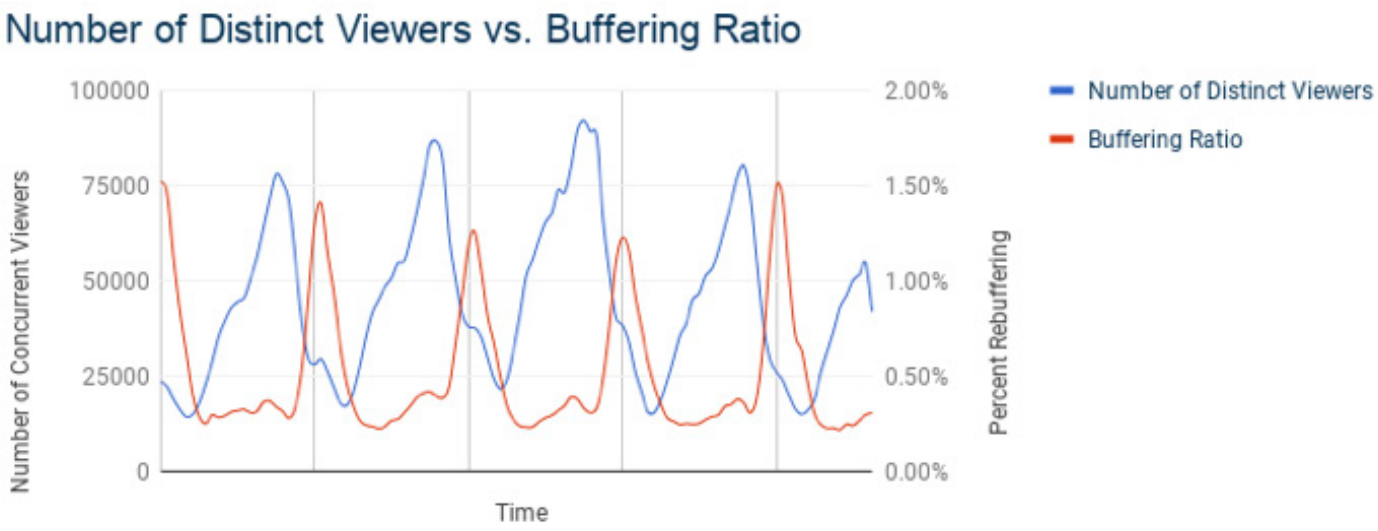



**Figure 2: Global buffering rate improvement during spikes**

With peer-to-peer technology, rebuffering rates decrease as more viewers tune in. Micro-caching on devices means that more segments across all formats and bitrates are available to the network to help with faster downloads and greater local and regional capacity

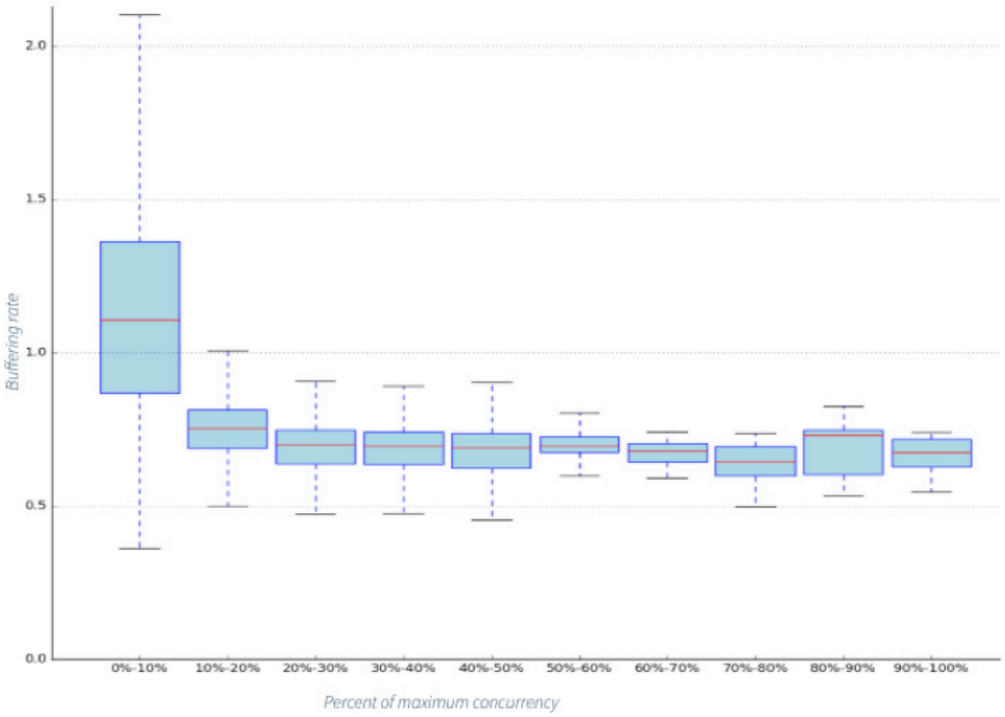



**Figure 3: Higher quality as concurrency increases**

Average and median buffering rates drop significantly lower as more devices connect to the streams.

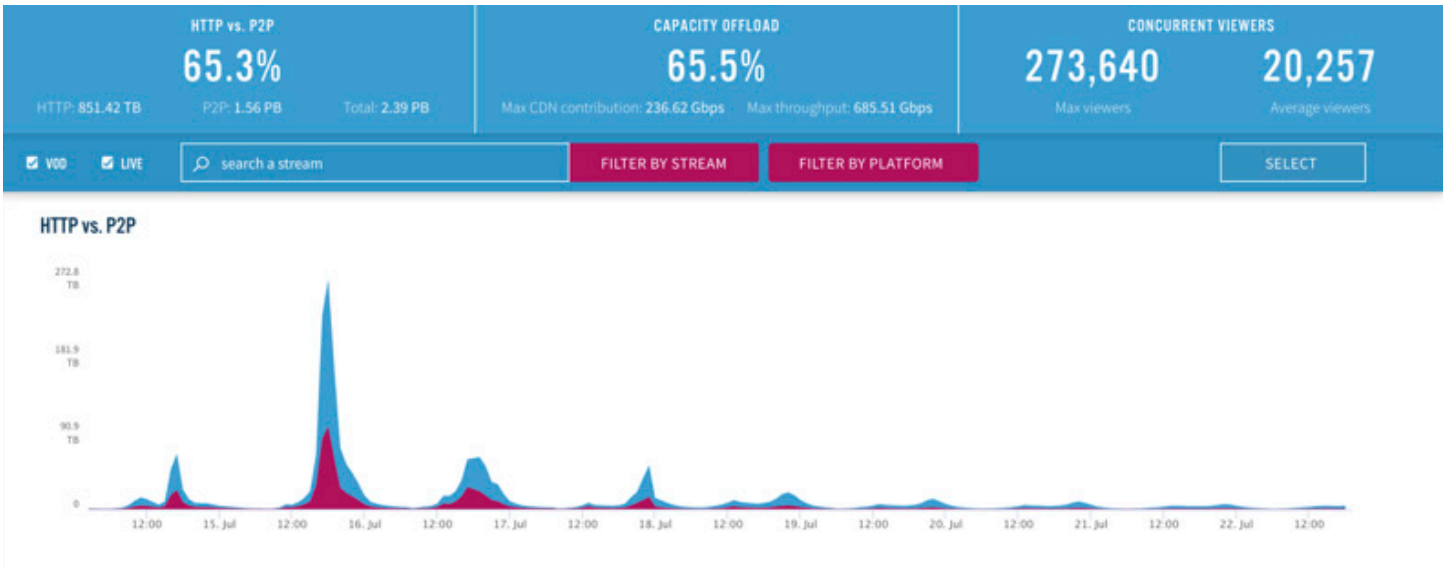



**Figure 4: Scaling to large-scale live events**

This national broadcaster calls upon peer-to-peer technology to scale to large, live sporting events, where traffic spikes can reach over 15 times its average nightly or weekly spikes. The figure shows traffic during the end of a record-breaking live event compared to habitual traffic levels. Peer-to-peer technology consistently delivers 65 percent of traffic on this platform.

# Why CenturyLink?

CenturyLink is trusted by many of the world's largest media, internet and entertainment companies for on-demand and streaming live broadcast content. You can directly connect to the CenturyLink IP backbone for high-performance delivery combined with connectivity to major cloud storage platforms like AWS, Google Cloud Platform and Microsoft Azure. Plus, our global CDN point of presence (POP) footprint extends to six continents and includes a mesh network topology that can deploy practically anywhere

Figures 1-4: Streamroot customer data February 2019

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