

## Solving Quality of Experience for the Last Mile

### QoE in adaptive video streaming

Over-the-Top or OTT streaming services are experiencing explosive growth. More than a billion people worldwide have already subscribed to one or more streaming services. Unlike traditional Pay TV services, subscribers expect to be able to consume streaming services and get excellent Quality of Experience (QoE) on any device, including TV and cell phone, and in any location (home, office, or anywhere in between).

Video streaming is typically delivered using Adaptive Bitrate (ABR) streaming protocol, which aims to vary the video bitrates according to the viewer's available bandwidth. The key metrics that affect users' QoE are:

QoE metric	Description
Startup time [sec]	The time from the initiation of play until video starts playing on the client's screen
Rebuffering ratio [%]	The fraction of streaming time a viewer experiences rebuffering/stalls
Average media bitrate [bits per second]	The number of bits received and decoded, divided by the total playing time
Lag behind live [sec]	For live events, the accumulated delay from the time a scene has been captured by the camera until it is watched by the user

### The delivery challenge

Most QoE issues in streaming video are related to the "last mile" delivery. The "last mile" refers to the path between the CDN edge node and the end user's device. Getting content across to users often involves multiple transfers between challenging and diverse network segments, whose conditions can change from one moment to the next. The advent of highly dynamic and volatile mobile and 5G networks, and of content consumption on-the-go, further aggravate the challenges for Internet data delivery.

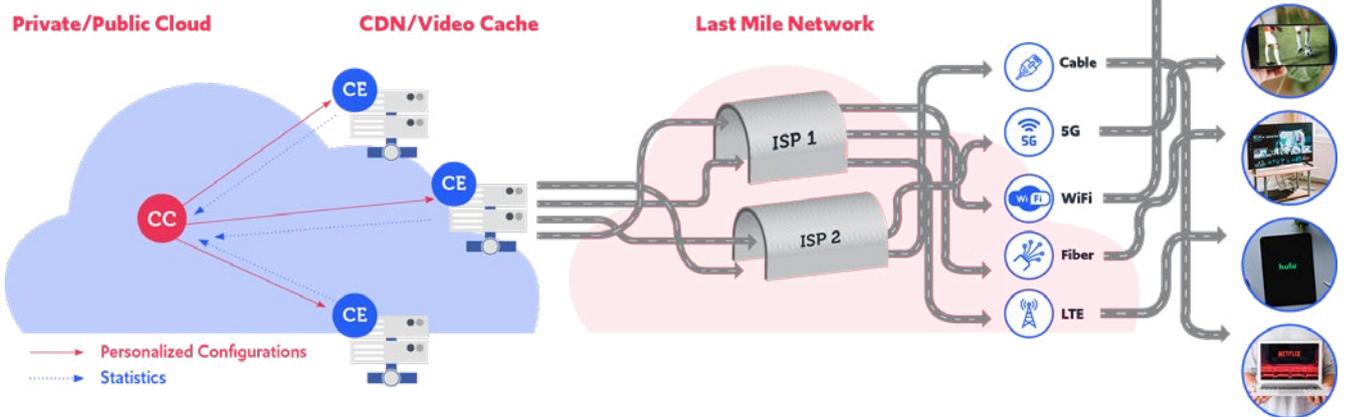
Service providers invest huge efforts into improving the network infrastructure and placing content close to users, while users purchase costly Internet access packages. Yet, today's Internet services still fail to provide universally high QoE. The root cause for this is that data delivery across the Internet reflects a "one-size-fits-all" approach.

Specifically, content delivery across the Internet does not adapt to the specific performance requirements of different services (e.g., live sports vs. VoD), nor to the prevailing network conditions (e.g., wired vs. mobile networks). This results in bad QoE; long delays for live streaming, high rebuffering ratios for VoD, and other reductions in quality.

## Our solution

Compira Labs provides service providers and CDNs with the means to optimize QoE for users via QoE-aware, online rate adaptation at the traffic sources. The sending rate is automatically tailored to the service-specific performance requirements and the local network conditions at each individual traffic origin. By upgrading the server-side network stack at the edge nodes, Compira Labs' next-generation congestion-control technology maximizes content delivery rates while minimizing data loss and network delays. Our ML-powered, big-data analytics engine provides visibility into the network conditions affecting QoE and continuously optimizes performance with respect to the service's needs and the actual network environments.

The Compira Labs solution is successfully deployed in production by CDNs, network operators and service providers across different networks, including wired, LTE and 5G, enabling superior QoE for their subscribers.



## Solution components

- **Compira Edge (CE)** – performs online-learning rate selection by employing Performance-oriented Congestion Control (PCC). The CE also continuously collects network statistics and supports remote configuration of the PCC element by Compira Cloud (CC). CE is available for TCP-based delivery (as a loadable Linux kernel module) as well as for QUIC.
- **Compira Cloud (CC)** – A machine learning-powered, cloud-based analytics engine. CC receives a continuous stream of network statistics from the CE elements and leverages these for:
  - customizing each individual CE to the specific QoE requirements of the services it delivers and to the prevailing network conditions at that CE.
  - providing visibility into network behavior via a multi-tenant SaaS dashboard.

## Benefits of Compira Labs' solution

- Significantly better QoE: 30% increase in the portion of HD sessions and 30% - 40% reduction in rebuffering ratio are typical gains in QoE metrics for users on both fixed and mobile networks
- Enables more advanced services: e.g. low latency streaming, UHD 4K, mixed reality
- Makes the most of the network, delaying investments in infrastructure
- Enhances visibility: dashboard allows network delivery data analytics at subnet, IP address, and single transport-layer connection granularity
- Seamless upgrade: software only, integrated on the server side only, transparent to video clients and video applications, encoding and format (HLS, MPEG-DASH) agnostic.