

CONVIVA™ PRECISION VIDEO

Policy based Multi-CDN Optimization

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1 OVERVIEW

Conviva Precision Video enables the delivery of high quality video to every single viewer with intelligent optimization and management of the tremendous heterogeneity and performance variability of Internet video delivery networks.

This document outlines some of the multi-CDN management policies that can be used to deliver high quality video at scale while optimizing the delivery economics. These policies include

- **Quality Policies:** for video quality optimization
- **Scalability Policies:** for management of scale and peak traffic loads
- **Economics Policies:** for optimization of delivery economics
- **Security Policies:** for enforcing multi-CDN security requirements

1.1 Policy Matching & Execution Model

Figure 1 shows the Conviva policy & execution model.

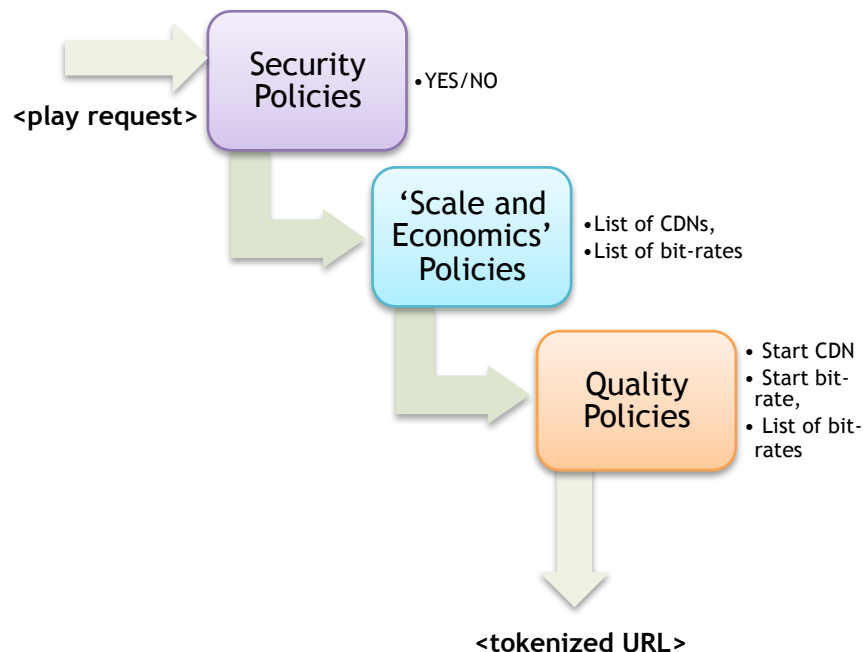


Figure 1: Conviva Policy Matching & Execution Model

The matching security policies are executed first to see if a video play request should be allowed or denied. An allowed play request is then matched with scale and economics policies to generate a candidate list of CDNs and bit-rates. Finally, the

quality policies are executed to determine the selected CDN and the starting bit rate and bit rate range for video playback.

For example, consider a video playback request from a viewer

1. **Security Policies** : Viewer request is checked against configured geo-blocking policy and is “allowed” access
3. **Scale and Economics Policies** : Viewer is detected to be requesting playback from France, so configured traffic policy selects Orange France CDN and Akamai as candidates
4. **Quality Policies** : Viewer is using Orange ISP, so Orange France is used as the start CDN with a start bit-rate of 1200Kbps and bit rate range of [800Kbps, 3600Kbps]

The following sections outline some of the quality, scale, economics and security policies that can be configured to optimize Internet video quality.

2 QUALITY POLICIES

2.1 Quality based CDN Selection

One of the most important policies used to optimize multi-CDN video quality is the availability and quality based CDN selection & switching. The policy can be configured by assigning an ordered list of CDN resources for video delivery to a selected traffic filter.

filter → *cdn_resource1, cdn_resource2, ...*

The policy selects the first CDN resource for matching video play requests but can seamlessly switch-over to other CDNs in the sequence based on measured video quality metrics. **Error! Reference source not found.** shows the video quality metrics that are monitored for every single viewer to detect CDN performance issues in real-time. Conviva monitors these metrics from every video playback and also aggregates and analyzes them in real-time to localize CDN performance issues.

Video Quality Metrics		
Start-time Quality Metrics	<i>Video Start Failures</i>	detects connection failures, missing asset failures and other streaming failures that cause video start failures
	<i>High Video Startup Time</i>	detects high time to first byte or high startup buffering times that cause video startup delays
Mid-Stream Quality Metrics	<i>High Buffering</i>	detects frequent or prolonged video buffering issues that cause video playback interruptions
	<i>Low Bit-Rate</i>	detects low bit-rate video playback due to local ISP congestion or CDN server overload

Figure 2: Video quality metrics monitored for every single viewer

✓ Example 1: Quality Optimization

Policy Format	<filter> → <ordered list of CDN resources>
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Example 1	<all site traffic> → L3_1, LL_1, AK_1
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✓ **Example 2 & 3: Viewer Quality Protection with Origin Delivery**

Policy Format	<filter> → <ordered list of CDN resources>
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Example 2	<site1 content> → internal CDN, AK_1, LL_1
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Example 3	<long tailed content> → Origin, L3_1, LL_1
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✓ **Example 4: Fail-over within a CDN**

Policy Format	<filter> → <ordered list of CDN resources>
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Example 4	<LIVE content> → L3_1, L3_2
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2.2 ISP based CDN Selection

Many CDNs, especially, Telco CDNs, have better performance with some ISPs compared to other ISPs. ISP based CDN selection policies can be used to optimize video quality by selecting the best CDN for various ISPs

ISP (& optional filters ...) → cdn_resource1, cdn_resource2, ...

✓ **Example 1: Simple ISP based CDN selection**

Policy Format	<ISP (& optional filters)> → <ordered list of CDN resources>
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Example 1	<ISP=Verizon> → Velocix, L3
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✓ **Example 2: ISP and other filters based CDN selection**

Policy Format	<ISP (& optional filters)> → <ordered list of CDN resources>
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Example 1	<ISP=Verizon AND content=premium> → Velocix, L3
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✓ **Example 3: ASN based CDN selection**

Policy Format	ISP (& optional filters)> → <ordered list of CDN resources>
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Example 1	<ASN=12345 OR 23456> → ATT, Akamai
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2.3 ISP based Bit-rate Selection

The varying performance of ISPs makes it critical to select the right starting bit rate and the bit-rate range for various viewers to deliver the best viewing experience. For example, a high starting bit-rate for a viewer using a wireless ISP such as Sprint on a moving train can cause high video startup delays and result in viewer abandonment of the video playback.

ISP (& optional filters ...) → start bit rate; [min bit rate, max bit rate]

✓ Example 1: Simple ISP based bit-rate selection

Policy Format	<ISP (& optional filters)> → start bit rate; [bit rate range]
Example 1	<ISP=Sprint or ATT> → 400Kbps; [400Kbps, 1800Kbps] <Default> → 1200Kbps; [800Kbps, 3600Kbps]

2.4 Device based Bit-rate Selection

The tremendous heterogeneity of the video playback devices also requires a careful selection of the starting bit rate and the range of bit rates available for video playback. The device based bit-rate selection policy can be used to optimize the video quality for viewers on various devices.

device (& optional filters ...) → start bit rate; [min bit rate, max bit rate]

✓ Example 1: Simple device based bit-rate selection

Policy Format	<Device (& optional filters)> → start bit rate; [bit rate range]
Example 1	<Device=iPhone> → 400Kbps; [400Kbps, 1800Kbps] <Device=XBOX> → 2400Kbps; [1200Kbps, 3600Kbps] <Default> → 1200Kbps; [800Kbps, 3600Kbps]

3 Scalability Policies

3.1 Traffic Sharing Policies

Handling peak traffic loads of 1 million viewers and more requires careful traffic sharing between multiple CDNs. Conviva's policies enable simple traffic sharing policies that can be used to split traffic between multiple CDNs. The policy for traffic sharing is as follows

filter → [% of traffic] : *cdn_resource1*, *cdn_resource2*, ...

✓ Example 1: Simple traffic sharing

Policy Format	<filter> → [% of traffic] <ordered list of CDNs>
Example 1	<All traffic> → 50% (LL_1, AK_1) → 50% (AK_1, LL_1)

The above policy directs 50% of the traffic to Limelight resource with Akamai as a secondary CDN resource. And directs the remaining 50% to Akamai resource with Limelight as a backup resource.

✓ Example 2: Traffic sharing to keep CDN caches 'warm'

Policy Format	<filter> → [% of traffic] <ordered list of CDNs>
Example 1	<All traffic> → 90% (LL_1, L3_1, AK_1) → 5% (L3_1, LL_1, AK_1) → 5% (AK_1, LL_1, L3_1)

The above policy directs 90% of the traffic to a Limelight resource with Level3 and Akamai as secondary CDN resources. And directs only 5% each to L3 and Akamai resources to keep the CDNs warm for instant switchover.

3.2 Geo based CDN Selection Policies

Delivering video globally requires the usage of multiple local and global CDNs. Conviva's geo based CDN selection policies can be used to direct traffic to specific local and global CDNs.

Geo filter → [% of traffic] : *cdn_resource1, cdn_resource2, ...*

The geo filter can be defined based on the country, state, city, zip code and US DMA of the viewer.

✓ **Example 1: Simple geo based CDN selection**

Policy Format	<geo filter> → [% of traffic] <ordered list of CDNs>
Example 1	<Country=US> → 50% (LL_1, AK_1) → 50% (AK_1, LL_1)
	<Country=France> → 90% (OrangeCDN_1, AK_1) → 10% (AK_1, OrangeCDN_1)
	<Country=China> → 100% (ChinaCache_1, AK_1)

The above policy directs traffic to various CDNs based on the location of the user.

4 Economics Policies

4.1 CDN Cost based Sequencing Policies

Because Conviva can instantly switchover a viewer from one CDN to another even in the middle of a stream playback, content publishers can use CDN sequencing policies to direct traffic to lower cost CDNs first to best optimize the economics of video delivery. The polices to sequence CDNs is defined below

filter → low cost cdn, high cost cdn, ...

- ✓ Example 1: Simple CDN sequencing based on delivery costs

Policy Format	<filter> → <ordered list of CDNs>
Example 1	<All traffic> → 100% (CDN_2centsGB, CDN_3centsGB)

The above policy directs 100% of the traffic first to the low cost CDN. In case of any quality issues, Conviva seamlessly switches over the traffic to the next higher cost CDN.

4.2 MSO based CDN Selection Policies

With TV Everywhere and growth of cable/MSO CDNs, content publishers can now take advantage of MSO affiliate relationships to offload content delivery costs to on-net affiliate CDNs. Conviva's MSO or affiliate based CDN selection policies can be used to direct traffic from specific MSOs to target MSO CDNs

affiliate or MSO filter → cdn_resource1, cdn_resource2, ...

- ✓ Example 1: Simple MSO based CDN selection

Policy Format	<Affiliate or MSO filter> → <ordered list of CDNs>
Example 1	<Affiliate=Verizon> → 100% (Velocix, Akamai) <Default> → 100% (Akamai, Limelight)

The above policy directs 100% of the traffic from Verizon affiliate to Velocix CDN.

4.3 Load Throttling Policies

Conviva provides load rate-limiting policies to ensure minimum or maximum CDN usage based on contractual commits or delivery network capacity. The policy for load throttling is defined below

cdn resource → max load in Gbps

✓ **Example 1: Simple load throttling of CDNs**

Policy Format	<filter> → cdn resource ; max load in Gbps
Example 1	<Ak_1> → 5000Gbps <Origin> → 5Gbps

The above policy directs ensures that Akamai gets a maximum load of 5000 Gbps while it restricts the load on the origin to only 5Gbps to protect origin from overload.

✓ **Example 2: Direct delivery from origin**

Policy Format	<filter> → [% traffic]; <ordered list of CDNs>
Example 1	<content=long tail content> → 100% (Origin, Akamai) <Origin> → 5Gbps

Content publishers who have their own internal origin or CDNs can safely deliver traffic from their origin with Conviva quality and load protection policies.

4.4 Viewer Type based Bit-Rate (SD/HD) Selection Policies

Conviva also provides simple bit-rate range selection policies to enforce SD/HD bit-rate choices for subscribers based on their subscription type

viewer type → min bit rate, max bit rate

✓ **Example 1: Viewer subscription based min and max bit rates**

Policy Format	<viewer filter> → min bit rate, max bit rate
Example 1	<viewer type = premium> → 1200Kbps, 5400Kbps <viewer type = free user> → 400Kbps, 1800 Kbps

4.5 Time of Day based CDN Selection Policies

Conviva also provides time of day and week of day based CDN selection policies to optimize various delivery resource usage

time of day filter → *cdn_resource1, cdn_resource2*

✓ **Example 1: Time of day based internal CDN usage**

Policy Format	<time of day filter> → <ordered list of CDNs>
Example 1	<time of day = 12PM-5AM> → (origin, LL) <time of day = 5AM-12PM> → (L3, LL)

The above policy directs traffic primarily to origin only in the early hours of the day when the load is low and no premium content is streamed.

