TELIA SOLUTIONS FOR MEDIA

SELF-SERVICE CLOUD VIDEO PLATFORM

GLOBAL HIGH-PERFORMANCE CDN

PROFESSIONAL CLOUD TV CHANNEL PLAYOUT

MANAGED VIDEO SERVICES AND CO-DEVELOPMENT

ABOUT TELIA

We are **Telia Company**, the New Generation Telco. Together with our customers, we are the hub in the digital ecosystem, bringing people, companies and societies closer what really matter to them.

Our approximately 20,800 talented colleagues serve millions of customers every day in one of the world's most connected regions. With a strong connectivity base, we are the hub in the digital ecosystem, empowering people, companies and societies to stay in touch with everything that matters 24/7/365 - on their terms. Headquartered in Stockholm, the heart of innovation and technology, we're set to change the industry and bring the world even closer for our customers.

ABOUT TELIA IN LATVIA

Telia Latvia (hereinafter – TELIA), a 100% subsidiary of Telia Company in Latvia, has been a trusted partner for many local and international companies in the business technologies segment. TELIA is one of the leading telecommunication service providers in Latvia for enterprise (B2B) segment, having implemented internet and data transmission solutions for its customers throughout Latvia and nearby region. TELIA can be proud of its constant communication network across the globe that has been developed thanks to a special Telia Company network division - Telia Carrier AB, nowadays the No.1 IP transit operator globally.

By enlarging the range of services, TELIA built one of the most modern data centres in the Baltics. TELIA operates the data centre since 2011, as well as is the first in the Baltic region to begin offering the latest generation advanced level cloud computing and virtual networking services based in this and other TELIA's data centres.

Recognizing the increasing share of video in the overall Internet traffic and having observed the massive shift from linear TV to consumption of OTT/on-demand content, TELIA has developed an easy to use, self-service, yet powerful and intuitive video platform, integrated to TELIA global CDN network for best content delivery, as well invested into R&D and competencies. Advanced technologies integrated into a single platform, dedicated support, flexible customization options, competitive pricing, global reach, continuous development and co-designing together with customers is what places TELIA in a unique position in the market.

TEAM OF EXPERTS

Out of nearly 20 800 employees employed by Telia Company in various countries, 48 highly skilled professionals are employed directly by TELIA in Latvia, most of whom are experts in their respective field of expertise – network, cloud and server infrastructure administration, software development, solution design, IT security, IP capacities and peering, helpdesk, monitoring, etc.

Most TELIA employees have received independent certification in their respective areas. We employ numerous Cisco Certified Network Professionals; Microsoft, Vmware, CloudStack professionals; Certified Linux and Windows administrators.

Telia Solutions for Media division is involved in delivering OTT projects and services since 2010. We have obtained significant experience with streaming technologies and develop our own parts of the content management backend.

WE ARE TRUSTED BY

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TELIA SOLUTIONS FOR MEDIA

Telia Solutions for Media (TSM) is a group of services aimed at online video and website content hosting, processing and delivery. Is consists of Telia Video Platform, an online video platform, Telia Cloud TV channel playout, Telia CDN+, a multi-CDN solution including a global content delivery network, regional CDN in the Nordics and Baltics and a CDN Selector.

TELIA CDN+

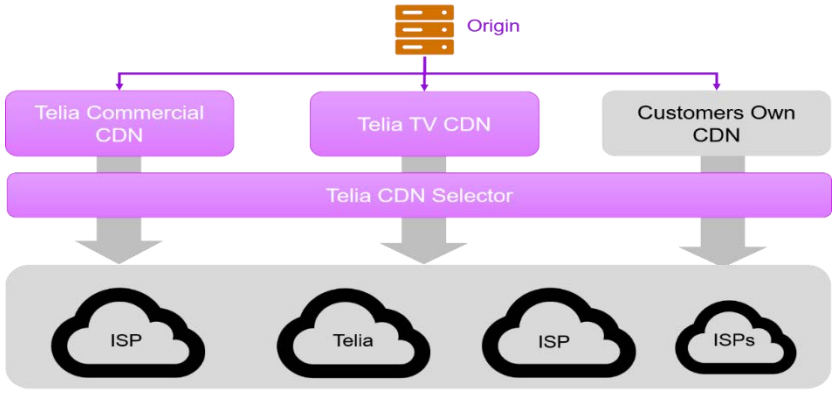
Telia CDN+ is an adaptable, multi-CDN service specifically designed for video and audio streaming. CDN+ provides a Selector service to combine multiple streaming CDNs. This enables you to dynamically select the best CDN to deliver from in order to achieve the best quality, lowest cost and best uptime for your video and audio services. You can combine your existing CDN(s) with commercial CDN services such as our own without changing your business or deployment models.

Our Selector uses the latest server-side technology hosted in our network for CDN selection, enabling you to add and combine CDNs without any client updates, SDKs, server-side coding, or changes to your workflows. By dynamically selecting the best CDN for delivery even down to each individual viewer, you can optimize capacity across your entire infrastructure of local CDN servers, global CDN providers and internet connections. You can even make selections based on the quality delivered to the viewers device in real-time to ensure a broadcast experience. In order to measure quality and control CDN selection our Selector delivers certain elements of the streams that would normally be delivered by the CDNs themselves. As you would normally pay the CDNs for this traffic, adding our Selector will simply transfer this cost to us rather than add any new cost.

The key benefits of our CDN+ service include:

- Combine your current CDN with any number of additional CDNs
- Optimize delivery redundancy, capacity, quality and cost now and in the future
- Improve performance of each of your CDN providers
- Reduce manual integration and operations
- Cost neutral

For customers of our CDN+, Telia can provide delivery via our own commercial CDN which is operated in partnership with Verizon's Edgecast service and our own-built, local Telia TV CDN. This combination provides un-matched local and global capacity and quality for Nordic and Baltic streaming service providers:



TELIA CONTENT DELIVERY NETWORK (CDN)

Telia CDN is a cloud service provided in partnership with Verizon Digital Media Services (known also as Edgecast) that brings speed, scale and security to any web content, be it website, web-based service or media streaming, resulting in faster content load speed, a better user experience and no worries about large traffic peaks. It prevents your site or streaming service from failing under heavy load or even attacks and scales the origin infrastructure to a global cloud network reaching 120 Tbps of global network capacity in over 165 locations on 6 continents and hundreds of teraflops of computing power. Telia guarantees 100% availability of the CDN service including 24x7 monitoring and issue resolution.

In the early days, the ideal CDN topology was a highly distributed tv network using a large number of servers and nodes to provide extensive last-mile coverage. Today, this type of highly distributed network is no longer necessary. Content is uniform and highly personalized. Internet access is available from broadband ISPs through cable, fiber and wireless. ISPs and carriers are more highly interconnected than ever. Legacy CDNs have become inefficient and expensive to maintain, and each small point of presence (PoP) can easily become overwhelmed by traffic spikes.

Telia's CDN addresses the realities of today's internet through its modern architecture and efficient network technologies. Our technology evolves with the internet, resulting in the highest performance of any CDN on the market, as much as 30 percent faster than the competition.

Architecture of the CDN

CDNs improve performance by shortening the delivery route for communications over the internet. Rather than serving content from a distant origin server, CDNs serve content from an edge server based on physical proximity to the user. The goal is to reduce latency and page-load time. Our CDN has optimized this concept for the modern internet landscape.

Centralized distribution topology

Instead of the legacy CDN approach that scatters tens of thousands of small PoPs across the globe, we strategically place Super PoPs with massive computing power and high-bandwidth capacity at dense internet exchange points. A Super PoP is a data center that serves one or more key geographic regions and contains all the types of edge servers that provide our services: cache network, web acceleration service, streaming services, route servers and our PCI-complaint network. Each of our Super PoPs interconnects with peering and routing partners to achieve faster speeds and higher redundancy than our competition.

Highest cache-hit ratio

When a user requests content (e.g. videos, images, files, etc.) that is not cached within the CDN, the edge server must make a request to the website owner's origin server to obtain a copy of the content. This "cache-miss" scenario is undesirable because the user loses the performance benefits of a CDN. The highly distributed architecture of legacy CDNs doesn't work well with highly personalized content, resulting in tens of thousands of cache misses and a severely degraded user experience.

In contrast, our architecture improves performance by enabling more requests to be served from cache (a "cache hit"). Our Super PoPs are engineered for horizontal scalability to enable load balancing at the application layer. Hundreds of powerful servers within each Super PoP work together as one highly efficient infrastructure that stores each object only once, resulting in a larger usable cache. The result: significantly improved cache-hit ratios.

Best server-to-delivery ratio

Because our CDN is cloud based, it allows you to meet surges in demand without over provisioning your equipment and capacity. By concentrating massive computing capacity and bandwidth, each Super PoP handles enormous traffic spikes without performance degradation, resulting in the best server-to-delivery ratio of any CDN.

Superior reliability and capacity

Centralized distribution combined with horizontal scaling also provide greater fault tolerance. Our proprietary design offers redundancy that allows our CDN to withstand DDoS attacks and recover from hardware failures.

We always ensure that our CDN runs on 50% capacity on its network, this is achieved by proactive monitoring of traffic conditions, our open peering policies, peering relationships and real time traffic shaping capabilities.

Network connections and interconnections

Our routing and network technologies further improve performance by providing the most efficient transport path.

Efficient Anycast routing

Our CDN uses Anycast to identify which Super PoP should serve content for any particular user. Anycast is a network addressing and routing methodology that allows multiple Super PoPs to use a single IP address when receiving requests over the internet. Each request uses network hops from a routing table to find the closest Super PoP. This technique eliminates the need for sluggish geo-based DNS lookups or multiple recursive Domain Name System queries required by legacy CDNs.

Network resiliency

Our CDN ensures network resiliency by redirecting traffic away from congested points on the network, such as routers, backbones or down edge servers. Using proprietary self-healing technology, our CDN performs self-diagnostics and automates network failovers instantly and seamlessly.

Minimal latency

Our CDN interconnects with more than 5,000 carriers and ISPs to expand our global footprint and ensure that content gets to users with the least possible latency. We continually increase this capacity and expand our network.

Patented caching algorithm

Our patented caching algorithm ensures the most efficient caching strategy for consistently high cache-hit ratios. In addition, our dynamic acceleration technology determines optimal TCP (Transmission Control Protocol) congestion window size to find the optimal balance between performance and stability.

Customizable delivery strategies

Instead of a one-size-fits-all solution for delivery and acceleration, different customizable delivery strategies are applied for different types of objects, e.g., videos, large files, small objects, etc.

Continuous enhancements

We’re continually working to incorporate new technologies and address emerging challenges with our commitment to a 12-18-month evolution cycle. Our entire network has been

completely revamped multiple times and is currently in its seventh generation. We're continually deploying the latest hardware to deliver better performance.

Advanced features

CDN provides advanced features that provide the means to optimize and secure the content delivery.

Origin Shield

Origin Shield establishes an additional gateway between the origin server, edge servers and customer devices in order to protect the origin from:

- Direct to origin denial of service attacks - some DDoS attacks can be designed to directly target origin server using its IP address. With Origin Shield, specific IP addresses can be whitelisted to ensure only legitimate traffic from approved sources reaches the origin.
- Spikes in traffic reaching the origin e.g. dynamic content requests. The additional gateway aggregates all requests to the origin and provides an additional layer of caching. It also applies TCP optimization and persistent connections to sites with a lot of dynamic content.

Origin Shield is enabled by default for TSM platform origin servers. It is highly recommended for all media delivery scenarios as it significantly reduces the load on origin and increases the cache efficiency.

Token Authentication

A mechanism to create a per user unique hash to secure content on the CDN platform thus preventing unauthorized access to HTTP assets. Primarily used to prevent hot linking to protected documents and media streams.

TSM platform adds tokens to media asset streams if requested to do so. CDN token check is configured according to customer requirements.

HTTPS content delivery (SSL certificates)

In order to deliver via HTTPS, the streaming domain has to be listed on an SSL certificate that is deployed on the CDN edge servers. SSL certificates are provided by default for TSM customers.

Rules Engine

Configuration of rules to modify components of HTTP requests and responses in the CDN based on different criteria to:

- Reduce bandwidth costs by specifying "origin pull" update intervals for each URL or object.
- Reduce load on origin servers by offloading processing of existing business rules.
- Improve content security by blocking hotlinking and other in-line leeching of content.

Provides control of URL (method/host/path/file/query string) and headers (cookies, time-to-live [TTLs], response code, etc.). Geo-location rules include configure access based on geographical locations.

For Telia Solutions customers rules are created by Telia Solutions administrators. Video content delivery is optimized by default in the platform but may be adjusted upon customer requests.

API

Our REST-compliant web services facilitate the integration of our CDN service into customer workflow(s), applications, or interfaces.

TELIA CLOUD PLAYOUT

Telia partners with Veset to provide all-in-one TV channel playout solution in the cloud.

Any type of TV channel can be produced with the cloud playout. You can have a full scale 24/7 TV channel, a popup channel for the specific event or a backup playout for redundancy with your main playout system.

Line up the content from media files or live sources, add graphics and send the resulting stream to the CDNs, ISPs or satellite base station for delivery to your viewers.

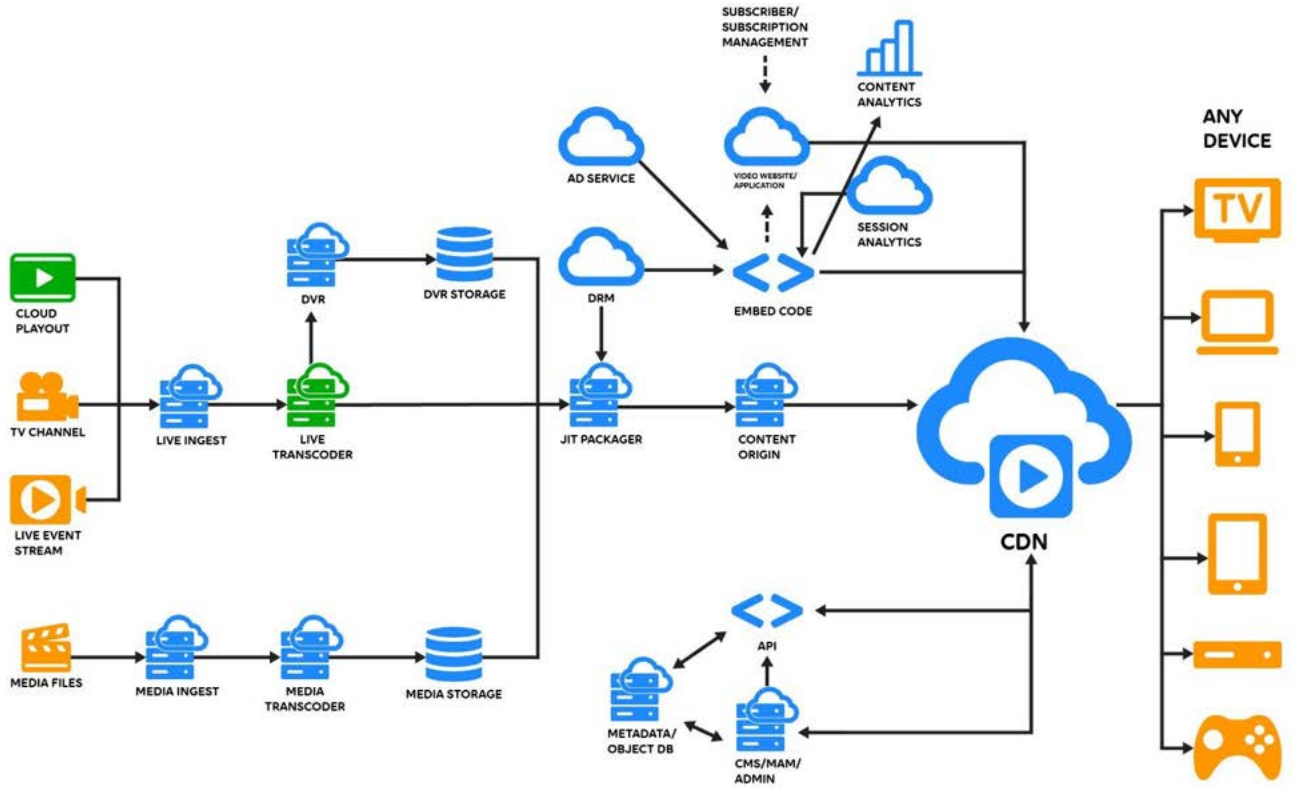
Telia Cloud Playout is available in two ways:

- Self-service Cloud Playout – manage the service yourself through the web interface.
- Managed Playout – we will keep the channel running for you.

Cloud Playout has RESTful API for integration with other systems.

TELIA VIDEO PLATFORM

Telia Video Platform consists of a set of components. Any relevant subset of components may be used and mixed with customer's systems where it is technologically feasible.



Content Ingest

Live channel content is ingested over IP network from customer's playout into TSM servers. Supported protocols are RTMP, UDP uni-/multi-cast, SRT (Secure Reliable Transfer), HLS (Apple HTTP Live Streaming). Multiple bitrate stream and multiple audio language ingest is supported.

To provide stable live content ingesting Telia will setup a dedicated data transmission channel into existing TSM servers.

VoD content can be ingested in several different ways. Simplest way is FTP upload which allows certain automation, for instance grouping of video, audio, subtitle and metadata files into a single compound video asset, categorizing assets and limited automatic transcoding.

More advanced upload is possible with TSM API where all uploading options are available. Content is pulled from the customer source servers over FTP or HTTP and all supported options and automation can be applied. We can establish custom ingest by using rsync or commercial services like Aspera.

Live Transcoder

Video Platform live transcoder takes the ingested live channel as input and transcodes it into the required number of profiles. AVC (h.264) protocol is used for most customers and HEVC (h.265) is supported. Resolutions up to 4K (2:1 4096x2048 or 16:9 3840x1920) are supported at framerates up to 60 fps.

Media Transcoder

Media assets ingested into Video Platform may be played back directly if they are in mp4 or mov formats. Video Platform recording or full adaptive bitrate channel for TV catch-up service. Recording the adaptive channel allows to publish the recording immediately without transcoding it.

Recordings may be done based on fixed time intervals or EPG schedule. Fixed time intervals can be 30 minutes, 1, 2 or 4 hours which is suitable for TV channel compliance recording. Other values are possible as well.

EPG schedule can be created manually in the web interface, loaded from XMLTV format file, loaded over API or from Veset Nimbus playout system. Integration with other playout systems supporting REST API is possible.

Packager

Video Platform on-the-fly packager creates Apple HLS, MPEG-DASH and Microsoft Smooth streams from live and VoD sources. All formats are supported simultaneously. If DRM is enabled for the channel or VoD asset, it is applied during packaging. The packager supports timeshift functionality.

Origin

Our origin servers are designed to support increased demand during the peak hours with most of the popular traffic cached in the CDN. As amount of the content in the system is constantly increasing to maintain the origin capacity we scale by adding new servers.

Advertisements

Client-side ad integration with 3rd party VAST or VPAID services is provided for AVoD monetization scenarios. Pre-/mid-/post-rolls at different content lengths are available for live and on-demand content.

DRM

Widevine and Playready are supported natively by Video Platform. Apple Fairplay support is possible but due to Apple policy holder of the content rights must acquire the necessary encryption means. DRM encryption is applied during packaging.

DRM functionality usually needs to be integrated with subscriber authentication system. It needs detailed specification to design a proper workflow, but it is possible to create such, and TSM API is ready for generic integration.

Metadata subsystem

We support ingest of metadata along with the media asset, use it for content business logic and display purpose.

Content/Media Asset Management system

Video Platform main component is the web-based self-service content and media asset management system. CMS/MAM manages all other system components and supervises the processes.

Some of Video Platform service components are not available in self-service manner. For those we provide the managed service as well as for customized solutions that most large customers usually need.

API

TSM REST API reflects functions and processes implemented in the whole system. API calls can be made to list, update and delete data, initiate processes and other tasks. API is documented and available to customer.

Analytics

Default analytics in the TSM is based on CDN logs which represent the usage of the service. Such analytics is available through the Video Platform web interface.

Google Analytics is integrated into the embed code player and registers player video events. Advanced GA services may be necessary to purchase from Google in case of large volume usage.

Additional optional advanced analytics tools are available. Currently the integration with NPAW Youbora is done. Other services like Conviva or similar can be added upon request.

Embed Code

Embeddable iframe is provided for all content. It is configurable and customizable to adjust to different needs. The industry leading HTML5 player by THEOplayer is used in the embed code and is compatible with most systems – computers, mobile devices, smart TVs, set-top-boxes and other.

Frontend Website

Video Platform platform comprises components to create customer facing website and integrate payment gateways, or implement some parts of them, e.g. those necessary for content monetization. A simple video website can be quickly built using our Wordpress based templates.

Integration with 3rd party frontend solutions is provided via our API or custom development on Telia Solutions side. Our customers have different type of frontend applications, e.g. website, set-top-box middleware, Android, Android TV, iOS, Apple TV, smart TV and game console applications.

INTEGRATIONS WITH EXTERNAL SYSTEMS

Possible integrations with other systems are listed below. There are two types of integrations – thirdparty systems interacting with TSM API or Video Platform interacting with third-party systems.

External systems interact with Video Platform in several ways. The most automated way which requires coding on the client's side is integration on API level to manage Video Platform objects and processes. Adding new functions to API is considered as our responsibility and we do this at no extra cost.

Content ingest to FTP server is another integration option which can be used both for human centred and automated processes.

Video Platform also can interact with external systems but that requires custom development and detailed specification to design such integration properly. We have extensive experience in developing such integrations, for example:

Customer origin integration with CDN

If customer has content on its own HTTP/HTTPS origin it may be integrated with CDN. Custom caching, security and processing rules can be created.

Subscriber management integration

Before opening the embed code player it is possible to validate the user session and in case it is not logged in, forward it to the login page. Before DRM allows the content to be decrypted a series of checks are performed with user validation among these.

Content management system

Though typically external CMS reads the lists and data from the Video Platform API it is also possible to integrate in the opposite way – Video Platform can update the external CMS and add, update and delete the references to the content and its data.

External analytics systems

Two types of external integration are possible. Export of CDN access logs and upload via FTP or another upload method is possible. This allow to analyze all requests towards the CDN, but it is not possible to identify user sessions from these.

For deeper use experience analysis integration on the player level is possible. Analytics systems like Conviva or NPAW have special plugins that work on Javascript level in the embed code and feed the data into their respective systems for analysis.

EPG fetch from playout or external source

While external system can upload EPG data via API we can also fetch this data from external sources. Advanced playout systems typically provide their timelines over API. Another option is reading the XML file from external link specified by customer or integrating via external API.

Source storage

Video Platform can integrate into customer's storage to monitor for incoming files in the FTP folder, read the downloadable asset list through API call or from remote XML file. Also, it is possible to implement rsync scenarios to synchronize content directories. This is used mostly during migration phases.

SUPPORT AND SLA

All Telia Solutions for Media systems are redundant and have 100% uptime guarantee.

Telia Premium support covers all issues that may arise during service usage and degrade the system performance or usage. Premium support works 24 hours a day, 7 days a week all year around. Amount of opened support cases and hours is not limited. Support is provided over the phone and email.

As Telia Solutions is a cloud service operational support at customer's premises is not necessary. All technologies are located in data centers that either have Telia personnel on-site or remote hands agreements with data center operators who provide necessary support to replace faulty devices. Monitoring and management of all technologies is done remotely by Telia or Verizon personnel.

Support cases have criticality levels:

Urgency	Response Time	Description	Status updates	Effort
Critical	15 min	Customer business is severely impacted and needs immediate resolution; several system functions not working; workaround not possible; needs resolution ASAP.	Hourly	24/7/365
High	60 min	Customer business is partly impacted; one system function is not working; workaround not possible; needs resolution expediously.	4 hours	24/7/365
Medium	120 min	Performance is degraded; workaround is possible.	24 hours	24/7/365
Low	Best effort	Minor problem/change request	When complete	Business hours

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