DVEO Solutions for IPTV and OTT Operators

Multi-Screen, Multi-Format and Multi-Protocol Architecture for Ultimate Versatility

Overview
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Introduction

Context
Never has the ongoing evolution in video and networking been so in favor of emerging IPTV/OTT and operators.
- IP has become the standard and cornerstone for all things video, whether in studios or distribution networks.
- Intense IP video technology competition leads to lower prices, with a great choice in all systems categories, hardware as well as software, and overall price/performance continues to develop very favorably.
- Formal and de facto industry standards and compliance mean that products are compatible and interoperable.

Most interestingly, this inflection point in technology allows entrepreneurs with limited means to create and launch OTT services while competing with much larger and established television enterprises for subscribers.

Background IPTV vs. OTT/Internet TV
At first IPTV was offered exclusively over managed networks by larger telcos, especially in Europe, after which it was adopted by medium-sized and smaller telcos as well. Ability to control the Quality of Service (QoS) was essential; therefore, owning and operating the network was a prerequisite for broadcast quality IP television services. The Internet was simply too unreliable for broadcast quality IPTV until just a few years ago.

Over-the-Top (OTT, a.k.a. Internet TV) delivery was initially used to provide free and ad-based content, pioneered by the likes of YouTube, where a television quality experience was not critical. Stuttering, re-buffering, video artifacts, etc., were common since the technology was new, and the target was personal computers and mobile devices, not the big screen.

Major advances in streaming video technology, together with vast improvements in broadband infrastructure, have taken place since 2010 when Move Networks introduced adaptive bit rate (ABR) streaming and was awarded a patent. ABR streaming was adopted by major companies such as Apple, Adobe Systems and Microsoft, enabling OTT services to be offered in HD with broadcast quality by the likes of Netflix, Amazon Prime, Hulu, etc. The trend was further strengthened by TV manufacturers offering integrated IP video connectivity in television sets, supported by a multitude of OTT apps.

The lower cost of OTT delivery is now challenging established cable and satellite TV operators, and even the managed network IPTV model. Recently AT&T announced a switch of delivery model from managed IPTV to OTT. The future will be all about Internet TV – and it is here now!

High-Performance Real-time Encoding, Transcoding and Streaming
Until recently, broadcasters and enterprises have had to make significant investments in fragmented systems for high-performance real-time encoding, transcoding and multi-protocol streaming. Now, all of that has changed. With the DVEO Encoder Transcoder Family, organizations get everything they need from one company at affordable cost.

The multi-screen DVEO Encoder Transcoder Family is an affordable way to perform real-time encoding and transcoding, whether MPEG-2, H.264/AVC or H.265/HEVC, and to deliver the highest-quality live and on-demand media with outstanding performance for IPTV, OTT and more. Offering proven technology built on Linux OS and the Intel Xeon platform, it supports all common adaptive bitrate (ABR) streaming protocols and resolutions.

The DVEO Atlas Media Server Family is a cost-efficient way to deliver live and on-demand multi-bitrate IPTV and OTT services. Offered turnkey with pre-configured hardware, software and DVCare™ customer support, these CAPEX friendly servers shorten time-to-market with reduced project risk compared to build-it-yourself software alternatives.

Moreover, DVEO’s award winning and patented DOZER™ ARQ technology guarantees error-free UDP video transport over any type of IP network including the public Internet.

The DVEO solutions’ advanced capabilities are enhanced by pre-integrated content security and digital rights management (DRM) from leaders such as Verimatrix®, and field-proven compatibility with major CDNs, enabling operators to respond with confidence to a rapidly evolving media landscape while containing both CAPEX and OPEX.

Applications
- Real-time encoding and transcoding to multiple output bitrates, resolutions and protocol wrappers
- Live and on-demand content processing for IPTV and OTT delivery over managed and unmanaged networks
- Ingest H.264 or H.265 live streams over IP, including repurposing of SDI and HD-SDI video feeds, then add wrappers such as HLS, HTTP Smooth Streaming, HTTP Dynamic Streaming, MPEG-DASH, or RTMP (Open Flash)
- Support for subtitles/closed captioning and multiple languages
- Build low-cost, high-quality video CDNs utilizing the public Internet enhanced by automated packet recovery
Solution Architecture Description

Introduction

The DVEO solution architecture for IPTV and OTT operators and services is depicted on the previous page. Below follow brief context and functional descriptions of each numbered item from 1 - 20 in the diagram. It should be noted that these descriptions are solely for illustrative purposes, and they neither provide exhaustive elaborations of all DVEO product capabilities, nor do they explore all architectural possibilities that could be realized.

Each video head-end and services delivery system has a set of specific requirements, depending on factors such as the operator business model, various local circumstances including CAPEX and OPEX budgets, content licensing objectives and constraints, regulatory framework, operational preferences and more. DVEO staff will be pleased to provide complimentary consultancy during the evaluation process and define the solutions that best will fit specific customer technical requirements and financial circumstances.

An introduction to DVEO and its solutions can be downloaded here. Moreover, the clicking on the links embedded in the descriptions below direct the reader to more detailed documents.

For the purpose of the discussion here, an end-to-end IPTV and OTT system can be divided into four main areas:

1. Content Acquisition
2. Content Aggregation & Head-end Processing
3. Multi-screen Distribution & Delivery
4. Presentation and Consumption

Each area will now be described briefly.

Stage [1]: Content Acquisition

1. File-based Content
   Non-real time content arrives over an IP network, to be stored in the head-end for subsequent scheduled playout.

2. Live Content
   Live content may be acquired via different kinds of networks, such as an IP-based CDN, and RF-based satellite, cable and terrestrial networks. In this case IP-based content, whether encoded in Standard Definition (SD) or High Definition (HD), arrives over a Content Delivery Network (CDN) or a fiber network, typically using UDP (User Datagram Protocol) from the point of live content origination. It is acquired and either rebroadcast immediately, or (as depicted) stored locally for on-demand play-out to subscribers requested it.

3. Off-air Broadcast Channels
   A video head-end may acquire off-air broadcast channels modulated according to some terrestrial broadcast standard (mostly ATSC/8VSB, DVB-T or DVB-T2, or ISDB-T depending on the world region), typically for immediate transcoding and re-broadcasting.

4. Satellite Content
   Content may also be acquired from satellite, typically delivered using the associated Digital Video Broadcast (DVB) standards (DVB-S or DVB-S2). The content may consist of broadcast channels, in which case the head-end will perform a “turn-around” by transcoding and re-broadcasting the channels. Content may also originate directly from a studio or other content provider, where satellite “backhaul” is a common method for delivery to the head-end. Such “backhauling” content may be transcoded and (re-)broadcast in real-time, or stored for later scheduled play-out.
   NOTE: Whichever way content is acquired, content license agreements need to be in place that define the legal, financial and technical parameters for the operator handling and distribution of the content. For example, this may stipulate deploying a system for strong content protection and Digital Rights Management (DRM), but also define other requirements such as building and content storage security.

5. Live Local Community Channel
   Operators benefit from providing local news and live events coverage, which stand out from the national channels and other syndicated content received via satellite and CDN. In this case, mounting one or two cameras at a local event, and providing a commentator, may be all that is needed to capture live content and pass it on to the head-end. Download a brief Application Note on how to stream live events.
IP TV and OTT Solutions

6 Descrambling and Transcoding

Content that is acquired from satellite and terrestrial networks will need to be demodulated and in many cases also descrambled since it may have been protected by one or more Conditional Access Systems (CAS) during transport. In most cases this requires separate Integrated Receiver Decoders (IRDs), equipped with the relevant CAS descrambling capabilities, together with equipment that can modify the video and audio encoding bit rate from that used on the incoming network to one suitable for the outgoing network, referred to as transcoding. This is a complex process.

The DVEO Gearbox™, a member of the DVEO Encoder and Transcoder family, is a broadcast quality, multi-channel and real-time transcoder supporting bitrates from 0.1-15 Mbps. However, what makes it a truly unique product is that also features the following functionality:

- Multiple optional IRD card (PCB) slots, with optional Conditional Access Modules (CAMs) based on the DVB Common Interface (DVB-CI) standard. CAMs are available for all major pay-TV CA systems such as NagrA, Irdeto, Conax, Verimatrix, etc. This integration into Gearbox saves a substantial amount of money compared to stacks of stand-alone IRDs.
- This DVEO advantage is enhanced further by that fact that Gearbox is capable of both descrambling the content and transcoding it, before passing it on to the next stage for content aggregation and head-end processing (which might involve re-scrambling using another CA system depending on operational circumstances, content license agreements, and the particulars of the targeted set-top box population).
- The Gearbox has multiple input and output options, and this data sheet describes a model with 16 DVB-S/S2 Tuners, ideal for acquiring a lot of content from satellite and transcoding it into various resolutions, with IP video output, all in a single and cost effective box. Available with IP and terrestrial broadcast inputs as well.
- Gearbox can be paired with DVEO Atlas Media Servers™ (see diagram), Wowza® and Adobe® Flash® servers.

7 Descrambling Other Content

If the incoming signals are scrambled by non-DVB CA systems or CA systems that do not offer DVB CAMs, a set of separate IRDs will be required in order to descramble the signals and pass them on to the second stage, being content aggregation and head-end processing.

The T-Ramp™ IP+DVB-S-S2+ASI/SDI+HDMI+ASI+IP is an advanced MPEG-2 and H.264 integrated receiver decoder for both HD and SD video. It receives signals from many different sources, including IP, ASI, DVB-S, and DVB-S2. Its numerous output interfaces include SDI, HD-SDI, HDMI, ASI, YPbPr, CVBS, and XLR audio, to meet many different system requirements. The T-Ramp also has two DVB-CI (Common Interface) slots that can decode multiple scrambled channels from various conditional access systems. Audio support includes embedded AAC or MPEG-1 Layer II on SDI ports, Dolby Digital® AC-3 pass-through, or analog audio output.

The unit also converts transport streams to IP, or decodes IP streams to many different outputs, making it ideal for IPTV systems and IP-based head-ends. It can be operated with front panel controls or web-based management software. With multiple inputs and outputs, the T-Ramp can be used in many different settings, including traditional head-ends and downlinks.

8 Live Encoding, Streaming and Automated Packet Loss Recovery

The DVEO MultiStreamer™ DIG/IP: TELCO accepts live video via SDI, HD-SDI or IP inputs (optionally HDMI), encodes it with a choice of bitrates and resolutions, and outputs it on IP using e.g. UDP for real-time transmission to the video head-end, where the DVEO D-Streamer IP/ASI™ receives and decodes the video and outputs it to other head-end components for further processing, or via HDMI to an HD Monitor for QA and so on. The D-Streamer is indeed the perfect complement to the DVEO Encoders and Transcoders.

The MultiStreamer in essence is a 1RU Linux-based, ultra-reliable SD/HD H.264 AVC real-time encoding and stream replication appliance with a variety of output options including common ABR protocols and RTMP. If used for OTT streaming it can support 500+ simultaneous HLS users. Content security is supported by pre-integration with Verimatrix® VCAS™ and other rotating key servers.
IPTV and OTT Solutions

9 DOZER ARQ

Both the MultiStreamer and D-Streamer are members of the DVEO Encoder and Transcoder family, all of which are equipped with DVEO’s patented DOZER technology, which automatically fixes packet loss that invariably occurs when real-time video is transmitted over congested private networks and the Internet. The Selective Repeat ARQ (Automatic Repeat Request) technology features DVEO automated packet recovery algorithms to fix packet loss in real-time. Error-free compressed video is passed on to the receiver for further processing.

DOZER ARQ technology is also offered on a stand-alone basis in the DOZERbox™ IP/IP + AES-128, in a 1RU rack mount version, and as a software license/SDK for integration in third-party video processing equipment.

Stage [2]: Content Aggregation and Head-end Processing

10 “IPTV in a Box”

The DVEO Infinity IP Server™ stores and plays up to 50 IP “web channels” continuously or by preset schedule via built-in scheduler and remote GUI. It takes input by IP video file transfer and stores it on its local 1 TB hard drive. It outputs the video in a variety of protocols and formats such as UDP, RTP, HTTP unicast and multicast TS with HLS, Smooth Streaming, or RTMP (Open Flash), in any video resolution. This “IPTV in a box” makes for a great self-contained server for ISPs, websites, hospitality, airports and digital signage applications (for chassis, see DelayServer below). An alternative to the above is the DelayServer IP™, a multi-channel transport stream or HLS delay server for Time Shifting. It accepts multi-protocol IP input/output, SD/HD, MPEG-2 or H.264; unicast and multicast, and outputs multiple delayed simultaneous IP streams, making it ideal for time shifting of IPTV and OTT services. It features Intel® High-end Solid State Drives (SSD) in lieu of bulky RAIDs. As the other DVEO servers, it also has a real-time, embedded Linux OS and comes in a 1 RU form factor.

Media Server (VOD) and Media Server (Live)

Media Servers are at the core of the IPTV and OTT services delivery system, and then can be used for both on-demand and live services. They can be positioned at the video head-end, and at regional and edge server locations.

The DVEO Atlas Media Server™ is a powerful IP Video Distribution Server with multi-channel grooming for Live and VOD applications. It supports multi-protocol IP input including MPEG-2, H.264, and H.265/HEVC live streams over IP, then “grooms” streams by adding various wrappers: HLS, MPEG-DASH, etc. Offered in three sizes and capacities, the Atlas is designed to serve 1,000 – 8,000 users simultaneously.

This product is ideal for IPTV/OTT operators, hospitality applications, and to build low-cost Private Delivery Networks (PDNs) and CDNs. Multiple units can be configured to scale to any needs as also shown in section 18.

Content Protection: Conditional Access System (CAS) / Digital Rights Management (DRM)

Content Protection is the process of securely determining if a particular viewer shall be granted access to specific content, e.g. a video/audio channel or an on-demand movie. There are several categories:

- **Geo-Blocking** – Restricting access based on user’s location, a relatively weak method of content security
- **CAS – Conditional Access System**: Transport content protection: Satellite, Cable, Terrestrial, IPTV
  - Required for ANY premium pay-TV content
  - Simulcrypt standard ensures interoperability MUX-CAS
- **DRM – Digital Rights Management**: Persistent content protection incl. storage; survives transport
  - Used for IP based video, in both IPTV and OTT applications
  - Limited standardization and interoperability

Distinctions between “CAS” and “DRM” are increasingly becoming blurred, especially for IPTV and OTT systems.

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Subscriber Management System (SMS)

The SMS is the core of a Customer Care system and stores all subscriber data, e.g. name, contact and payment information. It also holds the subscriptions that the viewer is entitled to, which may include channels, on-demand content, DVR support, and any other authorized devices. Since the SMS is the core of Customer Care, a Call Center will be required unless outsourced, or unless customer-facing functionality is made available online to allow for complete self-provisioning. However, it will also be necessary to consider Technical Support requirements for subscribers, so a Call Center might be unavoidable.

If a subscriber has several devices (whether at home or in different locations), it is referred to as a subscriber domain, which is the basis for TV Everywhere services; a user can start watching on one device and then continue on another. The SMS may include billing functionality too – if not a separate Billing System is required, or may be outsourced.

Transport Stream Analysis, Monitoring and Alarm Management

The DVEO Q-Check IP™: Head End is a scalable MPEG-2, H.264 and H.265 Transport Stream (TS) Analyzer performing 24/7/365 video monitoring and analysis for video head-ends. It simultaneously displays up to 66 TS while analyzing up to 200 TS. It verifies the quality of digital video services over IP networks, offering multi-window TS monitoring, analysis, error logging with multiple alarm types, and TS recording. It detects and logs e.g. video freezes, black screens, and loss of video, audio or subtitles, providing email and audio alarms, and it can also be managed remotely via SNMP. Optional ASI input or ASI plus IP input versions available.

Ad Insertion

As video services make their way from the point of origination to the viewers, there can be any number of reasons for the desire or need to insert or overlay a program with other content that may be informational, e.g.: TV station or network logo, sports results, promotions for programs coming up, commercial advertising, emergency alerts.

There are two types of ad insertion techniques:

- Static Ad Insertion: Ads are inserted in advance and cannot be replaced by the TV operator once the content is transmitted
- Dynamic (“Opportunistic”) Ad Insertion: Operators can provide targeted ads that can be inserted as the content is delivered to the viewer, combining e.g. content type, viewer profile, and geolocation data

DVEO offers ad insertion solutions that can be used for a variety of purposes, the DVEO Ad Serter and the Ad Spotter.

The DVEO Ad Serter™ offers these key features:

- Inserts or overlays graphics, video clips, logos, CG, scrolling text, and emergency alerts into live and stored video feeds on a schedule or via signaling like SCTE-35, with both HD or SD resolution support
- Static, rotating, flipping, or blinking graphics, logos, and text
- Drag-and-drop, scheduled play-out or via Cue Tones (SCTE-35)
- IP, ASI or SDI/HD-SDI inputs/outputs, MPEG-2 or H.264
- Inserts content in 1-20 IPTV, cable TV or on-air TV channels.

The DVEO Ad Spotter™ is a multi-criteria digital program insertion platform that takes above functionality further:

- Targeted, dynamic multi-criteria, multi-stream HLS Ad Inserter
- Combines content type, consumer profile, and geolocation data by "mining" multiple data bases in real-time
- Ads inserted inside, overlaid or around video content via slices, overlays, text crawls, alert bugs, and video squeezes
- Ad insertion initiated via various trigger mechanisms, e.g. SCTE-35 cue tones, contact closure, IP messaging, and scheduled or manual triggering.
Large Scale, Real-time Transcoding

With possibly a hundred channels or more being acquired from satellite and other content sources, there is a requirement to perform large scale and real-time transcoding in the head-end, in order to prepare content for output to the managed IPTV network or to a CDN and/or the Internet for OTT distribution. This may also be coupled with a requirement for on-the-fly ad insertion (see the previous section).

The DVEO Brutus™ VI. IP/IP: TELCO enterprise class real-time transcoder is an adaptive optimized transcoder and re-streamer for OTT, mobile and multiscreen Telco TV. It is ideal for IPTV/OTT/ISP/CDN multi-bitrate stream replication, supporting RTMP, HTTP, HLS, Smooth, and MPEG-DASH output streaming. Available in six configurations and capacities it can transcode up to 200 channels, and it can be paired with the DVEO Atlas Media Server™, Wowza® and Adobe® Flash® servers. Content security is supported through pre-integration with Verimatrix® VCAS™ and other rotating key servers.

This Telco grade product comes with SNMP support and like other DVEO encoders/transcoders and streamers, it features an embedded Linux® OS running on an Intel Xeon platform for maximum reliability and uptime.

Stage [3]: Multi-screen Distribution and Delivery

Delivery Networks

Delivery networks can be divided into two major categories:

- **Managed Networks**, typically owned and operated by the IPTV service provider and/or CDN providers.
  - These provide a guaranteed Quality of Service (Qos), such as a minimum bitrate for video.

- **The Internet**, which is used by OTT operators to reach their users.
  - There is typically no QoS unless a Service Level Agreement (SLA) is entered into with the network operator, but since most Internet delivered video will have to traverse multiple networks on its way to the consumers, this may not always be feasible.
  - Hence the emergence of modern adaptive bit rate (ABR) protocols, which means that each video stream is encoded at multiple bitrates, and where the receiver will select the stream with the highest bitrate that the network can sustain for the user’s device. This client-device controlled user experience is very different from the server-controlled, “one size fits all” approach of the past, which invariably left some users dissatisfied due to stuttering, re-buffering and other unacceptable interruptions to the television experience.

The DVEO Atlas Media Server family provides ideal “building blocks” for creating a low-cost CDN, or Private Delivery Network (PDN), where different Atlas capacities can be mixed and matched with the requirements for Origin Server, Regional Servers, and Edge Streamers.

Stage [4]: Presentation and Consumption

Traditional TVs and Smart/Connected TVs

“Dumb TVs” lack IP connectivity, in which case some kind of receiver or set-top box (STB) will be required to convert the incoming IP video signals to e.g. HDMI or composite video for output to the TV. Examples of such receivers (sometimes in USB stick format) would be various types of IP-STBs (Amino, Dune, and many more), Roku, ChromeCast, Apple TV and Amazon Fire TV. For managed IPTV services, the receivers are often customized to the service provider’s specifications and leased to subscribers by the operator. For OTT services, the receivers are invariably purchased in retail by the consumers.

Smart TVs have IP connectivity integrated in the set, which can be used to connect directly to the Internet. Smart TV manufacturers typically provide the user interface, which will display a mosaic of apps that can be activated to select various types of content. If the TV is either provided by the pay-TV operator or otherwise conditioned for use by a specific pay-TV provider, the default (home) screen will no doubt be that of the operator’s Electronic Program Guide (EPG).

Mobile Devices

Thanks to the advancements of ABR protocols, it is possible to enjoy a high-quality viewing experience on a variety of smart phones and tablets, such as iOS and Android devices, in addition to laptops and notebooks. The DVEO suite of encoders and streamers can address such devices in their native streaming formats, whether HLS, Smooth Streaming, or MPEG-DASH.

On the following pages additional illustrations are provided of the DVEO product deployment versatility.
### One Encoder — Multiple Destinations

- Create, packetize, encrypt, and aggregate source content
- Deliver to CDN, cloud host, private delivery infrastructure (PDI), and direct-to-device playback, simultaneously

### One Encoder — Multiple Sources

- Ingests multiple sources in multiple formats, saving cost and rack space by not requiring separate IRDs
- Encodes/transcodes to single and multi-rate profiles
- Deliver error-free video to CDN and/or PDI over the Internet with DOZER ARQ, for multi-screen play-out
Multi-Screen, Multi-Channel IPTV / OTT

- Connecting the DVEO Encoder/Transcoder directly to DVB and other RF network sources saves cost and rack space of separate IRDs, enabling cost-effective transcoding of multi-format, multi-channel IPTV/OTT services
- Content optionally encrypted using third-party DRM, and streamed into multiple IP video delivery networks

Live Event Broadcasting

- Connecting the DVEO Encoder to a video source enables multi-rate and multi-format live broadcasting
- Content optionally encrypted using third-party DRM for protected playback and delivered via a CDN for scaling to thousands of subscribers
- Deliver error-free video to CDN and/or PDI over the Internet with DOZER ARQ, for multi-screen play-out
About DVEO®

Overview
DVEO® is a privately held entity headquartered in San Diego, California, since 2001. DVEO develops and sells broadcast quality video encoding and streaming products, media servers and ad insertion solutions to leading broadcasters, telco TV/OTT and cable operators around the world. DVEO also designs and manufactures professional video products for OEM sales, and it is a private label marketer for a variety of complementary products from well-known corporations.

Vision & Mission
Our vision is to offer innovative and affordable digital video and telco TV grade products for IPTV, OTT, cable and broadcast applications that anticipate the evolving needs of progressive service providers and OEMs globally.

Our mission is to enable deployment of high-quality and easy-to-use, yet affordable solutions that enhance our clients’ profits and success by reducing CAPEX and OPEX, coupled with outstanding post-sales support.

Since the launch we have focused on fostering long term relationships and this client-first attitude has positioned us as a trusted solutions provider for customers of all types.

Market Approach
In addition to direct sales to video operators of all types, complemented by indirect channels, DVEO provides OEM solutions that shorten time-to-market while reducing project risk and cost. Product volumes range from single and custom units, to thousands of units a month to meet dynamic customer requirements. Above all, we pursue long term partnerships with our customers for sustained mutual benefits.

DVEO continuously pursues advanced R&D efforts in key technologies for IP video and communications, while utilizing formal and de facto industry standards whenever possible.

Product Range
DVEO provides broadcast-quality IP video encoders and transcoders, decoders, media servers and ad insertion solutions, together with patented and award winning IP gateway technology ensuring error-free real-time video delivery over UDP. The DVEO solutions enable multi-screen service delivery to any device, anytime, anywhere in the world. Deployment models include turnkey installations and cloud-based service delivery.

All solutions are built on Linux OS and Intel Xeon-based platforms to ensure 24x7 reliability, and feature DVEO-developed software for maximum flexibility and upgradability, ensuring long term investment protection.

These ultra-reliable products are matched by valuable pre-sales consultancy, outstanding post-sales service and support, and – not least – unusual affordability.

Worldwide Customer Base
Customers include ABC, CBS, Fox, NBC, PBS, Sinclair Broadcast Group, Time Warner, Arris, Cisco, Harmonic, Intel, Lightsquared, and Sony. In fact, most major broadcasting organizations worldwide have become our valued customers over the years, together with trail-blazing IP video operators. From traditional broadcasting to the demands of leading-edge IPTV and OTT, we stay at the forefront of the digital and IP video revolution to ensure that our customers can improve their competitive positioning and market share.

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