High Quality OTT Multi-screen Services featuring DVEO Encoding & Streaming with Verimatrix® Revenue Security

Solution Brief
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Adaptive Bitrate technology offers a client managed user experience, improving greatly on network managed QoS, while enabling scalable delivery of data using HTTP.

DVEO and Verimatrix offer a complete solution for encoding, packaging, streaming, and securing content to quickly and reliably deliver live and on-demand OTT services to ABR-enabled devices including Apple iOS and Android, PCs & Macs, and smart TVs/STBs.
Challenges of Over-the-Top Video Delivery

Traditionally, pay-TV services have been offered by using managed networks where the bandwidth, and hence the Quality of Service (QoS), is controlled and assured by the service operator. This arrangement has enabled pay-TV operators to deliver high-quality television services, including High Definition (HD), reliably and securely to subscribers connected directly to their managed networks via TVs and computers.

Since the introduction of the original iPhone in 2007 that heralded the transition from so-called feature phones to smart phones, there has been a proliferation of device types capable of video playback, including mobile devices, connected (“smart”) TVs, game consoles and more. These devices are typically connected via cable and telco operated IP networks and the public Internet, cellular 3G/4G networks, Wi-Fi hot spots and, increasingly, in-home local area networks. These networks allow users to surf the web conveniently, but they were generally not designed for real-time video delivery and, by extension, not designed for delivering a high-quality (broadcast) television experience.

Coming from a completely different world than traditional broadcasting and pay-TV, Over-the-Top (OTT, or Internet TV) video has always suffered from unmanaged, multi-hop distribution that forms the backbone of the World Wide Web. Video is a demanding type of content in terms of timely data packet delivery, and it requires high and stable transmission rates and very low rates of packet loss (rates as low as 0.1% will have a discernible impact on video quality). Unstable bandwidth causes long startup times, irritating stops and starts during playback due to re-buffering, a degraded video quality in general and, often, unpleasant audio effects.

These unpleasant effects have been partially compensated by improvements in compression algorithms and encoder silicon, expansion of content delivery networks (CDNs), and non-real time video delivery such as progressive download. However, CDNs can only improve QoS over limited segments of the underlying network and that does not guarantee subjectively acceptable Quality of Experience (QoE) for the consumer.

Solution: Adaptive Bitrate Streaming

The increasingly accepted substitute for managed network delivery of video is the technology of adaptive bitrate streaming (ABR), exemplified by a protocol originating from Apple, HTTP Live Streaming (HLS). While the technology emerged on the PC platform, it is a delivery format particularly well suited to mobile content delivery and for connected devices in general, including smart TVs and connected set-top boxes (STBs).

Adaptive Bitrate technology offers a client managed user experience, improving greatly on network managed QoS, while enabling scalable delivery of data using HTTP.

While multiple HTTP-based adaptive streaming formats have emerged in proprietary ecosystems, this document is primarily focused on the HLS format originally implemented by Apple and now supported by a vast and global ecosystem. Another ABR protocol, Smooth Streaming by Microsoft, has together with HLS gradually morphed into an international standard, Dynamic Adaptive Streaming over HTTP (also known as MPEG-DASH). Apple, though, is sticking to the HLS protocol for its iOS devices.
Mobile video went mainstream thanks to the ever more sophisticated smartphones and tablets with larger and higher resolution displays, high speed data access (4G/LTE and Wi-Fi), and reasonably priced (and increasingly unlimited) data plans. Apple in particular revolutionized the smartphone category by natively supporting HLS with multimedia capable devices such as the iPhone, iPad and iPod. Not to be outdone, Google with its Android OS has enabled fierce competition in the smartphone and tablet category illustrated by companies such as Samsung and a slew of others offering increasingly innovative multimedia devices based on Android.

In summary, ABR protocols enable the best possible QoE for each client device screen resolution and available bandwidth based on several inherent technology advantages:

- Automatic adaptation to each client device characteristics ensures locally optimized user QoE
- Broad network support – Broadband, 3G/4G/LTE wireless, Wi-Fi, etc, enables intra-network transition and automatic roaming handover.
- Firewall transparency – Tunnels through the home network router to all devices.
- Single URL – Enables support for a broad range of encoding bitrates and formats.
- Standards-based approach fosters interoperability and expansion of ecosystem.

Content Security and Rights Management Considerations

Content security, and the associated usage rights management, is the foundation for implementing pay-TV revenue models that enable successful OTT multi-screen service delivery. It is not enough to base security on e.g. user IDs and passwords, as evidenced by research from Parks & Associates\(^1\): "According to a 3Q 2014 survey of U.S. broadband households, 8% are using a subscription OTT video account held by someone outside of their home, and 6% are exclusively using shared accounts to access subscription OTT video content. This finding equates to 11% of all households that are relying exclusively on shared accounts when using subscription OTT services." "Account sharing" means loss of revenue for both operators and rights owners!

Commercial grade content and revenue security builds on fundamental aspects such as:

- Foundation: Public-Private Key Infrastructure (PKI) and X.509 digital certificates.
- Encryption: Robust AES algorithm with a 128-bit key length.
- Device authentication: Prior to entitling a user to any services, the device must be validated for the operator service domain.
- Entitlements verification: Before issuing a decryption key it is necessary to determine if the user has the right to the content.
- Secure key management: Upon positive entitlements verification, a key should be provided to the user’s device, or entire multi-device domain, securely.

Therefore, to summarize, the essential ingredients of a successful OTT business consists of:

- Desirable and premium content, increasingly delivered live ("broadcast") in addition to on-demand
- An easy-to-manage asset management, encoding and streaming media platform
- Consistent QoE for any client screen resolution and available bandwidth
- Secure multi-screen content delivery with transparent key and usage rights management.

One Solution for Maximum Quality of Experience and Content Security

DVEO provides Encoder/Transcoders and Media Servers that deliver high-quality live and on-demand video services at an affordable cost. With products such as the Brutus V transcoder and Atlas Media Server, operators benefit from DVEO-developed software on industry standard Linux OS and Intel Xeon high performance platforms.

Verimatrix specializes in securing and enhancing revenue for multi-network, multi-screen digital TV services around the globe. The award-winning and independently audited Verimatrix Video Content Authority System (VCAS™) and ViewRight® solutions enable cable, satellite, terrestrial, IPTV and OTT operators to cost-effectively extend their networks and enable new business models.

DVEO and Verimatrix offer a complete solution for encoding, packaging, streaming, and securing content to quickly and reliably deliver live and on-demand OTT services to ABR-enabled devices including Apple iOS, Android, Windows Phone OS, PCs & Macs, and smart TVs & STBs.

Solution Overview
The solution is architected around the DVEO Encoder/Transcoder and Media Server family complemented by the Verimatrix Video Content Authority System, VCAS™, for revenue security and subscriber domain rights management. It enables quick and secure media delivery to ABR-capable devices, ensuring that users are able to access authorized multimedia content on their authenticated devices while enjoying the highest QoE for any given bandwidth and display resolution. Like the DVEO products, VCAS also runs under Linux OS.

OTT content and revenue security is assured by the VCAS for Internet TV solution in combination with the DVEO platform that performs the AES encryption, complemented by a wide range of Verimatrix ViewRight® clients integrated with various OS-optimized media players.

VCAS for Internet TV can either be deployed standalone for dedicated OTT pay-TV services, or as part of a multi-network solution including managed IPTV, DVB, and hybrid broadcast-OTT services under a single security and media delivery head-end.

Content Download for Offline Viewing
The joint solution also enables services such as on-demand, secure content download for offline viewing, which allows the user to watch favorite movies when on-the-go and without a broadband connection. Content remains encrypted on the user's devices augmented by VCAS secure key management.

Multi-Device Domain Management
The solution also features multi-device subscriber domain management, enabling a user to utilize several devices as part of a single pay-TV subscription. When such a domain is entitled to specific content, all the devices of that domain are automatically entitled to the same content, thereby making the viewing experience completely frictionless - a key aspect when managing multi-screen services.
Complete Range of Encoders and Streamers

DVEO’s range of streaming products accommodates the needs from the smallest hospitality installation to large scale deployments. They provide multi-format and standards-based live and on-demand ABR encoding including support for multiple source inputs, capability to simultaneously write multiple outputs per input source (stream replication), and advanced features such as multi-rate live and on-demand file creation.

These products also feature DVEO’s patent-pending DOZER™ ARQ automated packet recovery technology, which enables error-free real-time UDP video transmission over congested backbone networks such as the public Internet. This is great for networks where operators prefer to use UDP, such as for long-haul real-time video transmission across countries or continents without incurring the bandwidth penalty and latency of Forward Error Correction (FEC) technologies. To learn more about the award winning² DOZER, click here or go to dveo.com/pdf/DOZERbox-Executive-Overview-Presentation.pdf.

Integrated OTT Solution Architecture

![Diagram of DVEO and Verimatrix Media Delivery Solution](image)

DVEO and Verimatrix Media Delivery Solution

Live and on-demand content streams are H.264 encoded/transcoded and prepared for HLS delivery by the DVEO Brutus V. The latter will pass the encoded content to the DVEO Atlas Media Server, which will exchange key information with VCAS and thereafter perform AES-128 encryption. The streamed content is received by a variety of devices equipped with Verimatrix ViewRight clients. The devices are first authenticated by VCAS as belonging to an bona fide (possibly multi-device) subscriber domain, and entitlement checking then ensures that only authorized devices receive keys that enable content decryption and rendering on the display.

Quick Delivery and Easy Set-up

The entire solution can be operational within a few weeks after acceptance of quotations and purchase orders.

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² Society of Broadcast Engineers (SBE) Technology Award 2014 for DVEO’s DOZER IP video traffic smoothing technology
### FEATURES and ADVANTAGES

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<th>FEATURE</th>
<th>SUPPORT</th>
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<tr>
<td>Extend the operator brand and subscriber relationship beyond the living room screen to multi-device end-user domains</td>
<td>✓</td>
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<td>Address the competitive impact and opportunities of the Internet, OTT and mobile video offerings</td>
<td>✓</td>
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<td>Offer personalized choices and pay-TV models across growing number of devices: Apple, Android and other mobile devices, PCs, Macs, game consoles, and smart TVs/STBs</td>
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<td>Enable service delivery and content monetization spanning multiple networks, whether managed or unmanaged, and geographies</td>
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<td>Full ability to deliver single and multi-bitrate media simultaneously</td>
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<td>Automatically create and manage content segments / playlists for HTTP Live Streaming and MPEG-DASH</td>
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<td>Secure content delivery via Verimatrix VCAS, incl. device authentication and entitlement checking, assuring revenue security</td>
<td>✓</td>
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<td>Deliver and archive live broadcasts for later on-demand access</td>
<td>✓</td>
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<td>Support re-broadcasting, time shifting and looped content to ABR</td>
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<td>Deliver on-demand media files for immediate consumption or download for offline viewing</td>
<td>✓</td>
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<td>Choice of optimized media players integrated with ViewRight Web</td>
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<td>Both DVEO and Verimatrix platforms run on industrial strength Linux OS, the most stable OS for enterprise critical applications</td>
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<td>Remote management and upgrading, and SNMP support</td>
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<td>Extensive client and session logging for report generation including full query parameter support</td>
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<td>Automatically deliver content across multiple servers to provide scalability</td>
<td>✓</td>
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<td>Fully supported by DVEO and Verimatrix customer care teams</td>
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Verimatrix VCAS for Internet TV

VCAS for Internet TV, powered by the multi-network VCAS Ultra™ platform, provides a complete multi-screen security solution for OTT services over networks implementing the HLS and MPEG-DASH protocols, supporting both live (broadcast) and video-on-demand content delivery. The award winning VCAS for Internet TV solution enhances the basic HLS and MPEG-DASH security model with capabilities that support subscription and transaction based pay-TV services. The software-based solution is built on proven cryptographic and secure electronic transaction concepts widely used in e-commerce applications, providing the same high level of digital TV security that Verimatrix is recognized for in 500+ IPTV deployments. Components:

- **Verimatrix Operator Management Interface (OMI)** – The core administrative component of VCAS, OMI provides a single integration point for customer care and middleware systems through a set of content, device and entitlement management interfaces. OMI enables VCAS domain-based business models for multi-screen services by providing homogenous subscriber and rights management for heterogeneous networks and devices: IPTV, OTT, broadcast, and hybrid broadcast-OTT combinations.

- **Verimatrix Adaptive Content Security Manager (ACSM)** – ACSM is the core component of VCAS for Internet TV. In combination with the OMI, ACSM secures cross-platform content delivery to a variety of device categories, including PC/Macs, Apple and Android mobile devices, STBs, connected TVs, etc. ACSM supports authentication, key distribution and user control and acts as the root Certificate Authority in a PKI hierarchy. It uses X.509 certificates to validate and authorize all content protection communication within the pay-TV network, including messaging between VCAS sub-system components as well as between the head-end system and authenticated subscriber receivers. ACSM ensures that decryption keys are managed and selectively distributed to authorized clients only.

ACSM also provides workflow support for on-demand asset encoding and encryption in combination with the Verimatrix VOD Encryption Manager (VEM/Adaptive) and the DVEO Media Servers.

- **Verimatrix MultiCAS/Adaptive** – MultiCAS/Adaptive is integrated with the high-performance DVEO Encoder/Transcoders and Streamers to enable key exchange and encryption. Encryption keys are generated by ACSM and provided to the DVEO server via the MultiCAS/Adaptive interface. The DVEO server then undertakes the actual AES encryption of the streaming chunks prior to downstream distribution. This interface supports:
  - Authenticated connections
  - Program stream identification
  - Keyfile URL generation for playlist references
  - Programmable key change interval
  - Scales to support any size of encoder array

- **Verimatrix ViewRight® Web** – The ViewRight Web clients provide cross-platform support for secure OTT content delivery to a variety of device categories, including iOS (iPhone, iPad, iPad Mini, iPod Touch), Android OS, Mac and Windows/PC computing platforms, Windows 8 Phone OS, and Connected TVs/STBs

- **Verimatrix VideoMark™ Forensic Watermarking** – The emergence of 4K/UHD video services is accompanied by redefined security requirements from the Hollywood studios for content protection. Forensic watermarking is a key requirement area as described by MovieLabs. VideoMark™ is a user-specific, forensic watermark technique that seeks to securely, robustly and imperceptibly embed identifying information within copies of media content. It meets UHD security compliance on 4K-capable client hardware platforms.
DVEO High-Performance Encoders/Transcoders and Media Servers

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.

Integrated with the Verimatrix VCAS for Internet TV proven content security and digital rights management (DRM), organizations can respond with confidence to a constantly evolving media landscape.

DVEO contributes two key components from its extensive Encoder/Transcoder and Media Server family:

- **DVEO Brutus™ V** – With a hundred channels or more 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.

  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 outputs.

  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. 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.

- **DVEO Atlas Media Server™** – The Atlas Media Server is a turnkey, cross-platform streaming media distribution platform designed for both live and stored (VOD) applications, delivering the highest quality user experience to consumers with ABR enabled devices.

  Atlas interfaces to VCAS via the Verimatrix MultiCAS/Adaptive key exchange interface, and it performs the AES encryption before outputting the live streams and, optionally, simultaneously storing the same streams as VOD files. This enables additional applications such as network PVR, Go Back TV, Catch-Up TV and so on.

Key features:

- Powerful IP Video Distribution Server with live grooming
- Multi-channel grooming for Live and VOD applications
- Ingests HD and SD format MPEG-2, H.264, H.265/HEVC live streams over IP
- “Grooms” streams by adding wrappers: HLS, DASH, etc.
- Multi-protocol IP input/output; three sizes and capacities
- Ideal for IPTV/OTT operators, closed circuit apps, CDNs
- Tested and confirmed compatible with leading CDNs and video streaming service providers: Akamai (incl. Octoshape), Limelight, Ustream, Verizon (incl. Edgecast), etc.
About the Companies

About Computer Modules Inc., and DVEO

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.

For the past several years DVEO has increasingly focused its development efforts on carrier grade IPTV and OTT encoding and streaming solutions. Today, DVEO provides software-based encoders, decoders and transcoders, media servers and ad insertion solutions, together with patented and award winning DOZER™ ARQ IP gateway technology ensuring error-free real-time video delivery over UDP. All solutions are built on Linux OS and Intel Xeon-based platforms to ensure 24x7 reliability, and feature DVEO-developed software for maximum flexibility, upgradability and cost effectiveness.

About Verimatrix

Verimatrix specializes in securing and enhancing revenue for multi-network, multi-screen digital TV services around the globe. The award-winning and independently audited Verimatrix Video Content Authority System (VCAS™) and ViewRight® solutions enable cable, satellite, terrestrial, IPTV and OTT operators to cost-effectively extend their networks and enable new business models. As the established leader in cardless security solutions, the company has leveraged its innovative 3-Dimensional Security approach to provide harmonized rights for premium content delivery to a range of devices over new hybrid network combinations. Maintaining close relationships with major studios, broadcasters, standards organizations and its unmatched partner ecosystem enables Verimatrix to provide a unique perspective on video business issues beyond content security as operators introduce new services to take advantage of the proliferation of connected devices. Verimatrix is an ISO 9001:2008 certified company.

For more information, please visit www.verimatrix.com, our Pay TV Views blog and follow us at @verimatrixinc, Facebook and LinkedIn to join the conversation.

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