



Carrier Multiscreen Video Services

WHITE paper

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CONVERGING VIDEO LANDSCAPE

Video streaming is one of the most popular applications for the new generation of Internet connected devices. Over the Top (OTT) access to content is becoming the norm. Because of this popularity and the large amount of bandwidth needed, it is estimated that video will comprise two-thirds of data traffic by 2015.

The industry is converging on a common transport for video based on HTTP adaptive streaming using Apple HLS, Microsoft Silverlight or Adobe Flash. Adaptive streaming is driven by the end points, where the client selects the highest bandwidth possible to deliver the best video playback experience. These new adaptive streaming protocols, along with existing progressive download and legacy RTSP/RTP protocols, have created a complex video service framework that is difficult to provision, automate and manage.

The video delivery paradigm has shifted from push-based linear channel delivery to include pull-based client driven content delivery. In the wholesale services and retail markets, tenant-specific resource and service requirements must be properly “contained” across media preparation and delivery to ensure the required firewalling and QoS service management.

The issues of how to encrypt protected content while maintaining a transport neutral delivery paradigm to a wide range of end point devices further complicates the matter. Most Digital Rights Management servers have either limited client support for a wide range of devices or are not open enough to work with the variety of adaptive streaming protocols.

CARRIER-CLASS MEDIA DELIVERY ISSUES

Carriers of all types are looking to deliver protected, high-quality media to any user on any screen over any type of network. The main challenges are in lack of an automatic provisioning framework that is open and flexible, but which allows each tenant or service to differ in back office connectivity, media preparation, video transport, DRM and connected devices.

- Video wholesale services require multi-tenant support, with each tenant subscribing to their expected delivery Quality of Service (QoS) and/or Class of Service (CoS).
- Resources required in the delivery path must be grouped and categorized into containers for the purpose of resource provisioning, monitoring, and dynamic resource adaptation for scale and fail-over.
- Containers must be virtualized as cloud resources, assignable on demand while preserving inter-tenant resource fire-walling.
- Resource provisioning must be tailorable for each container to provide a custom delivery flow governed by presubscribed QoS/CoS.
- Resources required on a delivery path are pre-

committed and dynamically adapted to account for spikes and fail-over.

- Transport networks should be treated as containers, so that different networks can be used separately or in aggregation with end-to-end QoS monitoring and enforcement.

Standards efforts including MPEG-IF, MPEG-DASH and IETF CDNI may eventually provide a guiding framework to help bring order to many of the issues above, but challenges remain in meeting immediate market needs.

AZUKI CONTAINER ARCHITECTURE

A container is a functional block with a common external interface. Inter-connected containers can be provisioned without the knowledge of container payload attributes. Each element of the Azuki solution is a container in the sense of the cloud-computing paradigm. All transactions are performed in an atomic and stateless manner allowing for scalability through the simple replication. The ability to offload demand provides the balance between dynamic resource allocation and the desire to centrally provision and manage resources.

AZUKI MEDIA DELIVERY ARCHITECTURE

Azuki's media preparation and client-side delivery services enable a quality user experience on any end device. Azuki presents a “virtual Set Top Box” solution architecture that provides end-to-end service controls by creating a multi-tenant delivery framework via containerization and “cloudification” of resources in the media preparation and delivery paths. Tenant specific attributes and QoS profiles are hidden within specific containers, making it possible to create a wholesale service provisioning framework.

At the top level, Azuki provides three basic containers (Figure 1):

- Azuki Preparation Processor
- Azuki Media Manager
- Azuki Content Controller

Azuki Preparation Processor provides transcoding, segmentation, DRM wrapping and media uploading; any of which can in turn be configured as a sub-container. All media packager containers are stateless functional blocks that can be hosted on the same server module or distributed across multiple servers. Sub-container functions can be “offloaded” to external resources such as a transcoding farm or DRM license key manager. Azuki reduces the complexity of operating multiple different external resources by providing a single interface and common workflow, independent from the various sub-container elements.

Azuki Media Manager publishes metadata for the purpose of correlating device, user and content in real time. It also serves as the scheduler for media preparation containers and sub-containers. Because

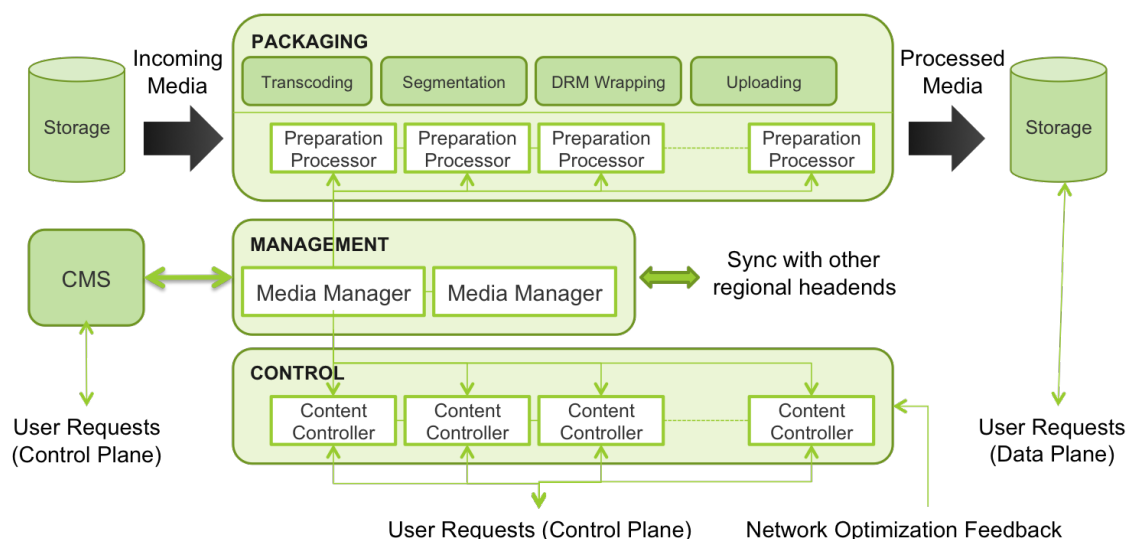


Figure 1: Azuki Media Platform™ Architecture

it is a database, it is a stateful module with redundancy. Each tenant can be thought of as owning redundant metadata management containers.

Azuki Content Controller performs a proxy function to support content delivery in the proper mode based on client requests: download, progressive download, streaming etc. It also performs the service mediation function including playlist handling and content license serving. The stateless nature of HTTP allows content control containers to scale, when coupled with load balancing switches, to add tenant-specific containers dynamically.

SCALABILITY

Containers are logical constructs and one or more containers may map to a physical resource. For example, a media packaging container may be responsible for providing resources needed for a particular tenant at service start-up time. More resources may initially be assigned for content ingestion and transcoding. Once service starts, those same physical resources could be assigned for media publishing.

The Azuki Media Manager assigns work to each container and is responsible for ensuring that the pipeline of work is allocated efficiently. For example, it is more efficient for the media packager container, which hosts the transcoding sub-container, to also host the segmenting and wrapping sub-containers in order to avoid needless network traffic. The pipelining of transcoding, segmenting, and wrapping sub-containers in a single container facilitates this optimization.

Quality of Service and Class of Service are implemented by prioritization of the resources by the metadata manager through its work queue manager. This container is also responsible for monitoring quality control and progress of the work through the media packager containers as well as delivery to the distribution networks.

FAULT TOLERANCE

The notion of stateless transactions allows the containers to implement a simple fault-tolerance model where a single media manager ensures that all content is ingested properly. The manager itself contains a database and is made fault-tolerant by use of a redundant database using the n-reader and 1-writer model for synchronization.

A container resource failure is addressed by using a different container. In other words, containers are completely disposable and can be readily instantiated and applied to handle the failed transaction.

AZUKI CONTENT PROTECTION WORKFLOW

The Azuki Digital Rights Manager function is an integral component of the media preparation. It is responsible for the management of content licenses, including the device registry. Through encryption, it preserves DRM protection over public or private content-delivery networks (streamed, downloaded, or archived offline to storage) by serving user and device-specific content keys.

The Azuki Media Client provides end-to-end controls for traffic management and content protection. The content controller provides service mediation and is responsible for setting up sessions and controlling bit rate and CDN routing. The client constantly monitors the digital stream to ensure the highest-quality service, preserves brand integrity, and authenticates usage through an external database that contains each subscriber's viewing rights data. Intelligent controls in the mobile device and Ad Proxy support the placement of targeted ads and enable new opportunities for monetization, end-user contact, and extensive analytics and reporting.

VIDEO DELIVERY WORKFLOW

Azuki integrates with existing workflows for n-screen delivery (Figure 2). Azuki's container and connector based architecture allow for the insertion of new functionality to

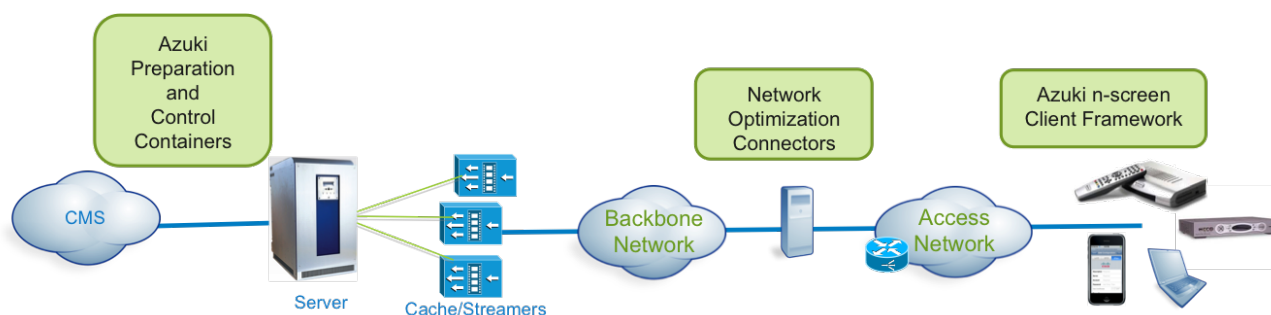


Figure 2: End-to-End Ecosystem for Video Services

rapidly address the requirements of new content flows, within existing network and management infrastructures. Azuki virtualized services provide real-time content management controls that provide both an optimized user experience and dynamic bandwidth management, that can scale to Internet-sized deployments.

Existing Content Management Systems (CMS) and Subscriber Management provide off-line content management services such as content packaging, pricing/billing, ad management and entitlements. The Azuki Preparation Processor integrates with the existing CMS during media acquisition, managing transcoding and metadata associations. In addition, it performs new functions to prepare content for posting to the delivery network, such as segmentation, encapsulation and DRM encryption. Azuki virtualized services then add real-time controls to manage data delivery such as device and client registration, DRM key management and service portals to generate authorized content playlists.

Content delivery leverages existing network resources for intelligent edge caching, pre-positioning, streaming and storage.

As video becomes a greater and greater percentage of traffic on networks, the video delivery system must work in conjunction with network transport. Traditional flow control mechanisms don't work for streaming video services, which can't tolerate delays or packet loss. Premium content is often encrypted, so the pacing and transrating schemes used for unprotected user-generated content also won't apply. The Azuki content delivery solution is able to respond immediately to network congestion indications and perform segment-based optimization and class of service bandwidth allocation, even for encrypted premium content.

The Azuki client framework completes delivery for best quality of experience while protecting premium content against hacking or piracy attempts. Azuki provides a client framework and SDK for connected TV, 2nd-screen delivery

The Azuki n-screen client performs:

- Device authentication and authorization
- DRM decryption with device hardening to prevent content copying
- Adaptive bitrate selection for optimal end-user experience
- Intelligent content reassembly for different bitrates and network sources
- Targeted dynamic ad insertion for additional monetization opportunities
- Extensive analytics to understand consumption patterns, network utilization, and for troubleshooting and error recovery

END-TO-END MANAGED CONTENT DELIVERY

Azuki enables the secure delivery of Video on Demand, Linear and Live content to any end device over any network. The Azuki cross-platform client framework (Figure 3) enables a number of critical features to be enforced through all phases of content delivery.

- Bandwidth Optimization - managed service delivery based on network conditions and user service level, even for encrypted content
- Universal DRM wrapping for premium content, extends protection from server to the target device
- End-to-end performance management with infrastructure server and app client. Server performs workflow automation, transcoding, segmentation, DRM wrapping, upload to CDN for both VoD and Live. Client performs adaptive streaming delivery, DRM enforcement and analytics.
- Connector-based architecture integrates with third-party CMS, rights management systems, ad networks, subscriber management and CDNs.



Figure 3: Azuki Cross-Platform Client

THE AZUKI ADVANTAGE

Without direct and rapid service expansion to mobile devices, carriers of all types face the prospect of declining subscriptions and lost revenue as consumers seek service alternatives. The Azuki media delivery solution provides:

- Low-cost, highly-scalable media distribution over advanced content-delivery networks
- Support for all major mobile operating systems—far beyond the homogenous world of STBs and PCs
- Strong end-to-end DRM protection using a single interface for all major smartphones and tablets
- Common workflow and interfaces compatible with existing first- and second-screen deployments
- Common billing and authentication interfaces
- Support for video markers and session shifting
- Transcoding and service mediation for all major device types, bit rates, and bandwidths
- Seamless handoff between 3/4G and WiFi networks that preserves the user experience

With Azuki, video content wholesalers can overcome the challenges associated with content extension and rapidly reach new consumers with their own TV Everywhere initiatives.

SUMMARY

Azuki's cloud-based solution can be overlaid over any server infrastructure to provide optimized workflow for efficient deployment and delivery. Azuki's connector-based architecture is consistent with existing content-delivery workflows and supports multiple Content Delivery Networks, including dynamic (policy-based) optimized request routing. Network optimization accommodates virtual playlists with traffic management and bandwidth controls, and a unified, agile workflow spans acquisition and media preparation for storage and streaming. Compatibility with existing workflow components—transcoders, rights managers, ad networks, and storage systems—provides a scalable and cost-effective deployment architecture employing a private cloud model via a container paradigm.

Universal Digital Rights Management optimized for mobile devices is a critical requirement to enable premium content delivery. Seamless studio-grade end-to-end content protection supports OTT delivery across all popular mobile devices.

Customers demand the highest-quality content delivery. Azuki provides a turnkey solution for delivering video-on-demand and live content. Azuki's universal ingestion and delivery workflow is optimized for both user generated and premium content for the best overall user and network experience.