ORASTREAM SERVICE

White Paper

CONTENTS

INTRODUCTION

The OraStream Service (“OraStream”) is an end-to-end audio delivery platform for a new generation of cloud music services (“HD Service”) to offer full native resolution music in lossless quality on any network or player device.

OraStream uses MPEG-4 SLS Non-Core audio codec, a scalable to full high-resolution audio coding method to deliver the HD Service. The HD service is a digital music store that offers 16-bit lossless and 24-bit high-resolution audio quality music for download purchases and on-demand streaming subscriptions with related album artwork, liner notes and other metadata, whenever available.

Downloads and on-demand streaming are accessible via web and desktop digital music store on desktop computers. Streaming is available via mobile apps downloadable from Google Play and iOS App Store.

HD SERVICE ARCHITECTURE

The HD Service Architecture comprises of these main components:

Business Back-end

Front-end Clients

API Back-end

Content Back-end

These software components are set-up and delivered via professional software services on a cloud-hosting infrastructure designated by the music service provider. To-date, OraStream has been implemented in cloud storage, servers and content delivery network infrastructure offered by Amazon Web Services and Microsoft Azure.

BUSINESS BACK-END

The business back-end comprises the digital store services (downloads and subscriptions) payment layers including user registration, management and fulfilment, e-commerce checkout and payment/billing functions.

FRONT-END CLIENTS

The front-end are web or desktop-based and mobile player applications based on JavaScript, CSS and HTML5 interfaces that handle 16/24-bit audio resolution playback on Windows, Mac, Android and iOS platforms respectively. Functional blocks (delivered via API requests in the App Stack) include keyword search for album, artist and track titles, filtering by audio resolution, by genre or alphabetical order, browse by latest, popular and featured albums (via carousel), playlist creation and removal, user settings for bitrate streaming quality. The web and desktop-based clients handle downloads in FLAC, ALAC, WAV and AIFF formats.

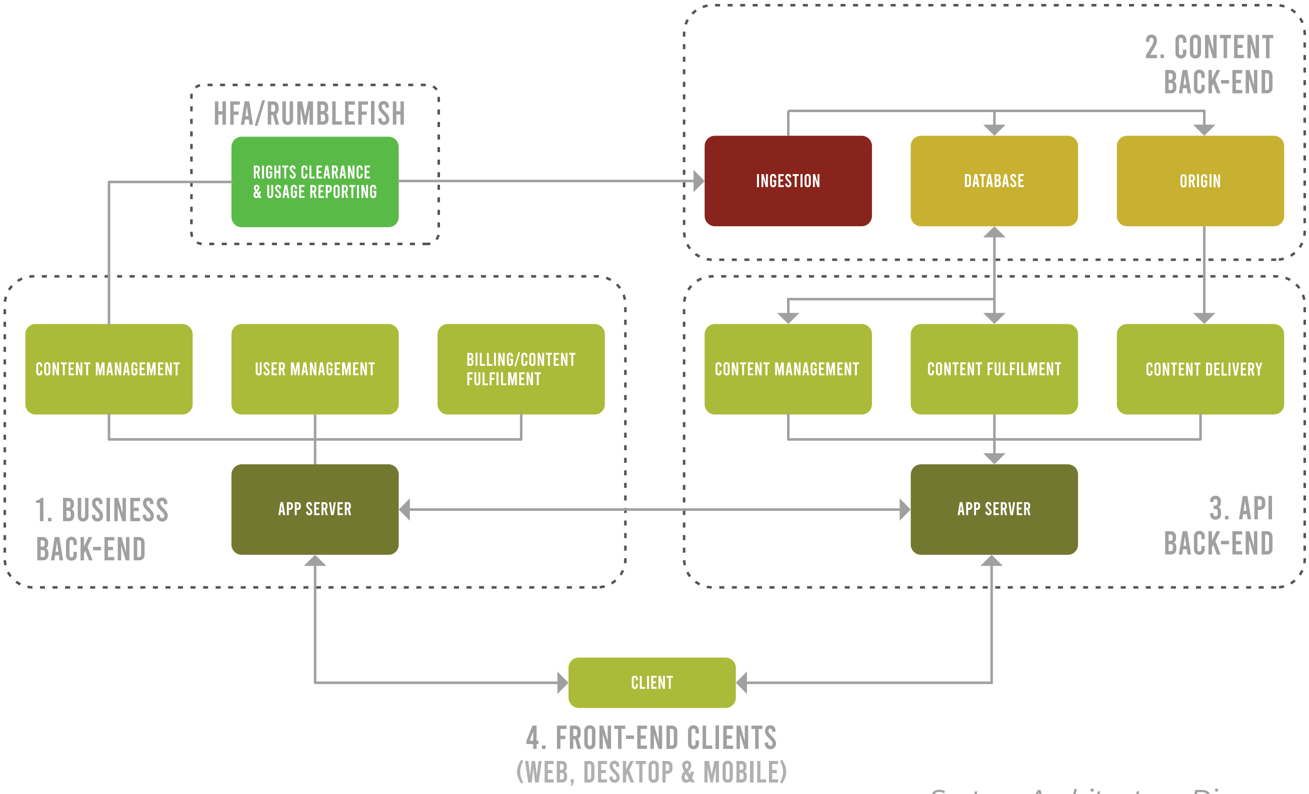
API BACK-END

The API back-end is the server middleware for handling content management, content fulfilment and content delivery via high-concurrency API and file requests. Each app server hosts Mongo content databases with redundancy and high availability/fail-over protection. The REST-based APIs handle content requests for albums, songs, artists, genres, and playlists. The APIs also support user authentication as well as content delivery requests for music streams and media files. Finally, APIs for delivery statistics are also supported, including stream-based data for usage and related-transactions reporting. (i.e. user ID and IP address, platform, stream volume, track ID, bandwidth, etc.)

CONTENT BACK-END

The content back-end is the ingestion system comprising an encoder server that directs text-based (DDEX) metadata to a primary Mongo database server (with secondary database) and audio-file based assets to an origin storage (server) which handles secured signing content delivery connections only to delivery servers. The back-end may also be interfaced with Rumblefish for publishing rights clearing and usage reporting.

ORASTREAM SOFTWARE COMPONENTS	PHYSICAL LOCATION (US, EU, OR ASIA-PACIFIC)
Business Back-end - Web/API and MongoDB servers	Azure Esv3-series or AWS EC2 R5-series servers behind an elastic load balancer located in US, EU, or Asia-Pacific.
Front-end Clients- web or desktop-based and mobile player applications	Any licensed territory with Internet Access. Azure DNS or AWS Route 52 service available worldwide.
API Back-end - Web/API and MongoDB servers	Azure Esv3-series or AWS EC2 R5-series servers behind an elastic load balancer located in US, EU, or Asia-Pacific.
Content Back-end - Web/API and MongoDB servers	Azure Esv3-series or AWS EC2 R5-series servers and Azure Blob or AWS S3 Storage with secured signing to auto-scaling streaming serveres behind elastic load balancer. Azure Esv3-series or AWS EC2 R5-series servers and Azure Blob or AWS S3 Storage are co-located in US, EU, or Asia-Pacific.



System Architecture Diagram

The HTML5 front-end gets content authorisation from the user authentication database via the HD Service app server. A user will receive an authentication token after logging in and this token will be used for authenticating all download purchases and/or streaming requests. Once authorized with user authentication web token, the token will grant the user access to album track downloads and full length audio streams from HD Service. Each stream request will include the web token which is used by the App Stack to the authorisation system for authentication.

CONTENT INGESTION, FORMATS & STORAGE

OraStream ingests audio assets and its related metadata in DDEX or XML format via automated ingestion based on secured FTP server or access key pair to AWS or Microsoft Azure cloud storage. A typical delivery package should include accompanying DDEX-based or equivalent metadata and file-based assets like images, PDFs and actual audio tracks.

Audio assets are taken into the system in FLAC format and encoded in enhanced form of MPEG-4 SLS format so that they are lossless, fine-grained scalable and can be easily truncated when used for adaptive streaming. The tracks will also be readily converted to the required lossless format for end-users' downloads. Associated metadata received with the audio assets are stored in MongoDB and hosted on a fully-managed, globally distributed, database platform as a service for mission-critical applications (e.g. Azure Cosmos DB system). Content metadata may also be delivered electronically to Rumblefish/Harry Fox Agency to handle automated licensing clearing. Once licensing/metadata integrity checks and asset transfers are completed, the content can be made available for the HD Service.

Details of MPEG-4 SLS format are available here. As MPEG-4 SLS is a bit-perfect, lossless audio coding format, based upon the download format requests of customers, MPEG-4 SLS encoded audio files are reconstructed in FLAC, ALAC, WAV and AIFF formats for permanent digital download content delivery. For streaming, MPEG-4 SLS encoded audio files are truncated for fixed bit-rate or adaptive bit-rate quality delivery.

Bit-rate audio truncation and streaming dynamically adapts in real-time to bandwidth on player devices (PC browsers and mobile-devices). This process enables optimal quality-of-service and quality-of-entertainment experience for end-users. Except for the last-mile (local loop) to end-users' player devices, audio delivery is transmitted via content delivery networks. (e.g. AWS CloudFront or Verizon Edgecast services)

THE HD SERVICE

The HD Service is a digital music store. The music store is organised for navigation and browsing by the latest and most popular albums. Upon selection, the album page will detail the cover art, album liner notes and biographies (where available) and 30 seconds preview samples. Users can also do a basic search by album, artist or track or an advanced search based on configurable parameters.

Users can browse and listen to 30 seconds clips of music anonymously. Users can choose to purchase a permanent download by registering via the HD Service. Digital permanent downloads are offered in lossless formats, such as, FLAC, ALAC, AIFF and WAV and DSD, when available.

Users can also choose to purchase a subscription by registering via the HD Service. Once a subscription is purchased, users will be given an authentication token each time s/he access the HD Service to stream and listen to full audio tracks.

Digital permanent downloads are offered in lossless audio formats such as, FLAC, ALAC, AIFF and WAV and DSD. Most of the music catalog will be available in 16b/44k, 24b/44k, 48k, 88k, 96k, 176k and 192k audio quality. Streams are delivered via HTTPS-based streaming protocol; either in fixed bitrate quality or scalable bitrate quality which is adaptive to the (speed of) users' network connections. With a good quality network connection, audio streaming can scale up to 192k/24bit full-resolution (bit–perfect lossless) audio quality.

END-USER EXPERIENCE

THE HD SERVICE RAISES THE END-USER'S EXPERIENCE IN MUSIC LISTENING WITH QUALITY ADAPTIVE STREAMING.

The HD Service can be accessible on personal computers and mobile devices running Windows and Mac and iOS and Android operating systems respectively. Users can request digital downloads on front-end web and desktop apps on personal computers. On-demand streaming can be accessible on personal computers and mobile apps from Google Play and iOS App Store.

Users register to sign up an account on HD Service. Only registered users can purchase permanent downloads and/or on-demand streaming subscriptions. Payment purchases are transacted and processed via PAYPAL. Users are required to sign-up/login their PayPal account credentials or provide credit/debit card details (as a guest user) on PayPal to checkout. Upon confirmation of payment processing from PAYPAL, users' purchases are authenticated and a session/user access token is included in the users' requests to be processed and validated on delivery servers. With an authentication token, users will be permitted to access the HD Service to download and/or stream full audio tracks.

Digital permanent downloads are DRM-free. Downloads are delivered to web- browsers, desktop-manager app and saved on users' personal storage devices.

On-demand streams are encoded using MPEG-4 SLS and require a MPEG-4 SLS decoder to obtain and playback the content in PCM/WAV format. Streaming audio quality adapts dynamically to network conditions to deliver the best musical fidelity at any given moment in time. With a fast consistent network, streaming up to 192 kHz/24-bit high resolution audio is smooth and lossless; at a slower or inconsistent network, streaming scales to mp3 lossy quality and remains uninterrupted.

> “ORASTREAM'S TECHNOLOGY DELIVERS THE BEST FIDELITY ONE WOULD EVER HEAR WITH DIGITAL MUSIC STREAMING TODAY. AS BANDWIDTH INCREASES, THE MUSIC WILL INCREASE IN QUALITY TO THE HIGHEST LEVEL POSSIBLE, SUBJECT ONLY TO THE QUALITY OF THE ORIGINAL MUSIC SOURCE.”
>
> *Celebrated singer-songwriter and musician, Neil Young*

SECURITY

The HD Service will use a highly secure cloud foundation managed by Amazon Web Services or Microsoft. Both AWS and Microsoft Azure uses multi-layered, built-in security controls integrated into hardware and firmware components to help identify and protect against threats, such as DDoS.

PHYSICAL/NETWORK SECURITY & BACKUP

The HD Service will be hosted and located in a Tier-1 data center located in the United States, EU or Asia-Pacific, as desired by the music service provider. It is secured by the physical security provisions found in Tier 1 data centers globally. Access to production API gateway instances will be protected by IAM policies with remote push access restricted to a single IAM user. Access to production pushes are limited to OraStream or the music service provider office static IP, accessed via local connection or VPN. Production users are required to manage their passwords utilizing password as a passphrase safe on their deployment keys. Devices with deployment keys are password protected and encrypted. All servers are configured with firewalls and can only be accessed by servers within the permissible access list.

Content security will be enforced with the following provisions:

- Use of HTTPS/SSL/TLS for encrypted traffic
- Checks for Security HTTP Headers
- Protection against Brute Force/DDOS attacks
- Protection against cross-site scripting and command injection

It utilizes signed URLs for downloads and streaming requests, a user access token based on JSON Web Token (JWT or equivalent) will be used to represent a user's purchase claims. All signed URLs for download and streaming requests will be formed using JWT when successfully validated, a time-limited URL will be signed and returned by the server for full access. Typically, the expiry time of the signed URL will be between 120 to 500 second. URLs signed for limited time access via will not be accessible once expiry time is reached. A new key pair used for URL signing may also be regenerated whenever a breach is suspected.

All streams are delivered via HTTPS to prevent snooping or other forms of man-in-the-middle operation. Each audio frame delivered in MPEG-4 SLS format will contain an encrypted frame header to scramble related frame information and prevent unauthorized parsing and decoding. Only the correct key pair can be used to decrypt and unscramble the frame headers for proper decoding and playback. Whenever any key pair is changed or if user access token has been validated to be expired or related to a terminated account, all cached downloads will also be configured to expire and purged from cache storage.

Production data in the HD Service leverages on AWS or Azure Cosmos DB infrastructure for backup and disaster recovery. The Azure Cosmos DB is Microsoft's globally distributed, multi-model database service for mission-critical applications. All API and database servers are configured for high-availability and fail-over operations. Database updates are synchronized between primary and secondary members in the replica set instantaneously. In addition, all database records are backed up to Azure Blob storage via scheduled daily data dumps. All delivery servers are configured for auto-scaling to mitigate traffic fluctuations dynamically. Traffic is managed through an elastic load balancer for fail-over protection and improved fault tolerance/high availability.

Operating systems and software packages of production servers are managed via AWS, Microsoft Azure or third party vendors. OraStream source codes are managed in a private software repository managed by Unfuddle. GIT is used for documenting software changes and code updates. Software projects and modules are organised based on deployment for production or testing and staging purposes.

In the event of a system failure, a notice will be put up to inform users of the downtime. Staff on duty will then proceed to locate component faults in the infrastructure and ensure all data is still intact and accessible. When all faults have been rectified and data is found to be destroyed (partially or completely), the most recently backup data will be retrieved from cloud storage, recovered and applied to the system.

SECURITY MANAGEMENT

Security management is natively part of AWS and Azure. All virtual servers are auto-provisioned, monitored and protected by AWS and Azure. Events collected from the security centres are correlated in the security analytics engine to provide recommendations and threat detection alerts. Such alerts will be investigated to make sure that malicious attacks are not taking place.

In addition, audit and network access logging will be enabled on network firewalls via the Virtual Network to monitor access activity. All servers' rate-limit user connections from a single IP address are detected and logged for any high-frequency access for potential DDOS attacks. All subsequent requests from the same IP address will be dropped and system admin will be notified via email.

Server access and transactional logs are stored in Azure Cosmos-MongoDB for up to 3 years. Audit and access logging are enabled on network firewalls to monitor access activity. All servers' rate-limit user connections from a single IP address are detected and logged for any high-frequency access for potential DDOS attacks. Traffic from the offending IP address is black-listed and blocked indefinitely.

Further action may be taken to take down accounts and/or invalidate passwords/tokens of identified users suspected in the breach. The rightful user will then be notified of the incident and asked to reset his/her password immediately. Users are authenticated using user authentication token and in suspected or actual security breach cases, existing tokens will be invalidated and all users will need to re-login and re-validate to receive a new access token.

ACCOUNTING & REPORTING

The HD Service tracks content playback event by logging content usage events via the delivery servers. Content usage (downloads and stream counts) and related transactional events are logged and saved into MongoDB to generate reports for royalty clearances and content/service usage reports. These relevant service data can be compiled, analyzed and summarized for periodic reporting of sales analytics of downloads and subscriptions, track listens and users' signups as well as usage counts for royalties accounting of downloads and streaming transactions attributable to recording labels and publishers in relevant territories.

The content usage accounts and business reports generated from the relevant service data are presented on a web-based admin dashboard for the music service provider and/or content labels as required.

ORASTREAM

www.orastream.com