

Multi-Asset Protected Content Multimedia Delivery System

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Introduction

In a multimedia delivery system, such as the adaptive bitrate streaming system disclosed in U.S. Patent Application Serial No. 13/221,682 entitled "Systems and Methods for Adaptive Bitrate Streaming of Media Stored in Matroska Container Files Using Hypertext Transfer Protocol" to Braness et al., filed August 30, 2011, with a variety of delivery mechanisms such as streaming and download, it is often necessary to divide the title asset in to multiple individual assets. These assets could represent multiple audio, video, and subtitle streams, and some assets could be encoded according to conditions which make them suitable for varying data rate transmissions. The availability of multiple individual assets enables the multimedia delivery client application the flexibility to dynamically select which assets will be delivered based on a variety of conditions including variable bandwidth, geo-restrictions, the license that has been purchased, or other conditions. It also enables the multimedia delivery client application to switch between assets being consumed in real-time as the deciding criteria or data rate conditions change dynamically.

The protection of multiple assets representing a single multimedia title presents a challenge when those assets are consumed simultaneously and seamlessly switched between without any latency from reinitializing a protection context or key store. The process of ingesting multiple protected assets of a single multimedia title into a multimedia content licensing system also becomes a challenge when those assets may not enter the system at the same time. The enclosed invention presents a solution for protecting multiple assets for a single title that solves these challenges.

Invention

There are two challenges that are to be solved by this invention. The first is how to protect content in such a way that the protection spans across multiple assets of a title. The second is how to ingest the content into the multimedia content licensing system in such a way that allows for the above mentioned content protection scheme that spans across multiple assets.

Multiple Asset Content Protection:

The basis for content protection in the Rovi (DivX) DRM is frame protection. This involves encrypting a portion of each frame of the title with frame keys. The frame key table is then encrypted with a session key. The encrypted frame key table is placed in the titles file container or file structure and the session is sent up to the multimedia content server's database. In this scheme the encrypted or protected frame keys are only stored in the file container of the title after they are encrypted with the session key. With this scheme, the multimedia content system assumes the title consists of one asset that contains all of the components and streams of the title and the multimedia delivery client application can only consume media within that one asset.

In order for a multimedia delivery client application to be able to consume the title in the form of multiple assets, each asset is protected within the same key space. This enables the multimedia delivery client application the flexibility to select any of the multiple assets and switch between assets without the need to maintain multiple protection contexts or key tables or without the need to reinitialize the protection engine with different key tables. A single instance of a frame key table defines the key space for a title for a particular protection scheme.

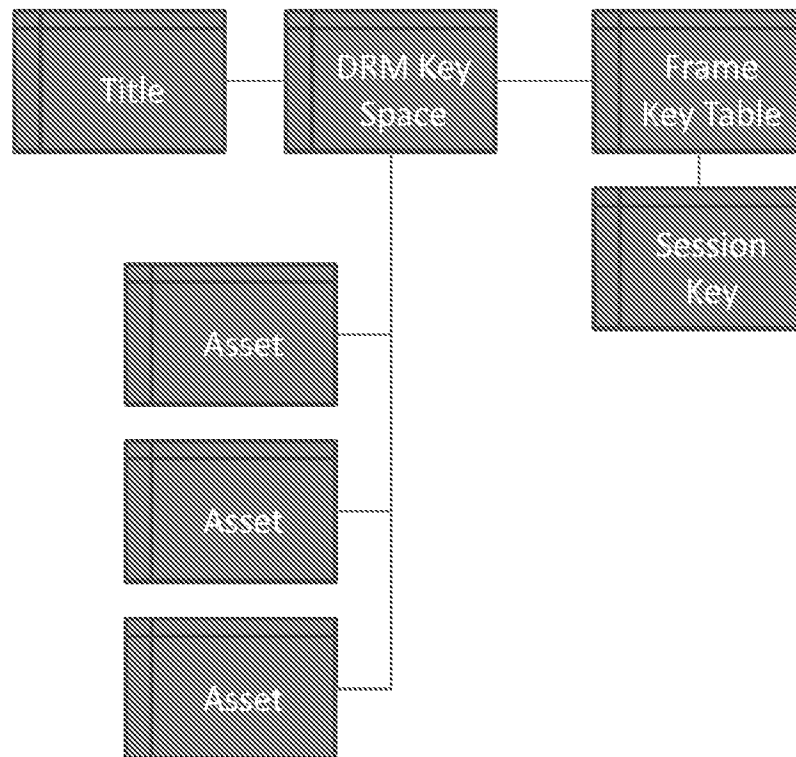


Figure 1

Figure 1 shows the data relationship. Within a title there is a key space. This key space represents the frame keys that are used to protect each of the assets.

Multiple Asset Content Preparation & Ingestion:

In order to facilitate the above mentioned multiple asset content protection scheme, the frame keys are accessible to the content protection and ingestion tool so that when an asset is processed for ingestion into the multimedia content system, the ingestion and protection tool can perform frame encryption on the asset within the same key space as the rest of the assets within the title. This requires the frame keys to be generated and stored on the multimedia content server. When the content protection and ingestion tool creates a title and adds the first asset to the title, it requests the frame keys from the multimedia content server in order to perform frame encryption on the asset. In addition, the multimedia content server returns a unique identifier (title ID), through which the title can be identified. When the content ingestion tool adds an additional asset to a pre-existing title, the content ingestion

tool makes a request to the multimedia content server to receive the frame keys that it can use to perform frame encryption on the asset, using the unique identifier associated with the title. The availability of the frame keys in the multimedia content server for a title and their association with the unique identifier enable the addition of assets at different time intervals. The frame keys are also provided to the content protection and ingestion tool in the form of protected frame key table or the frame key table encrypted by the session key. This is delivered to the content ingestion tool in order to store it in the asset's file container. The protected frame keys are stored in each of the assets file container or file structure to allow the multimedia delivery client application the flexibility to deliver and consume any of the assets in any order and switch between them at any time.

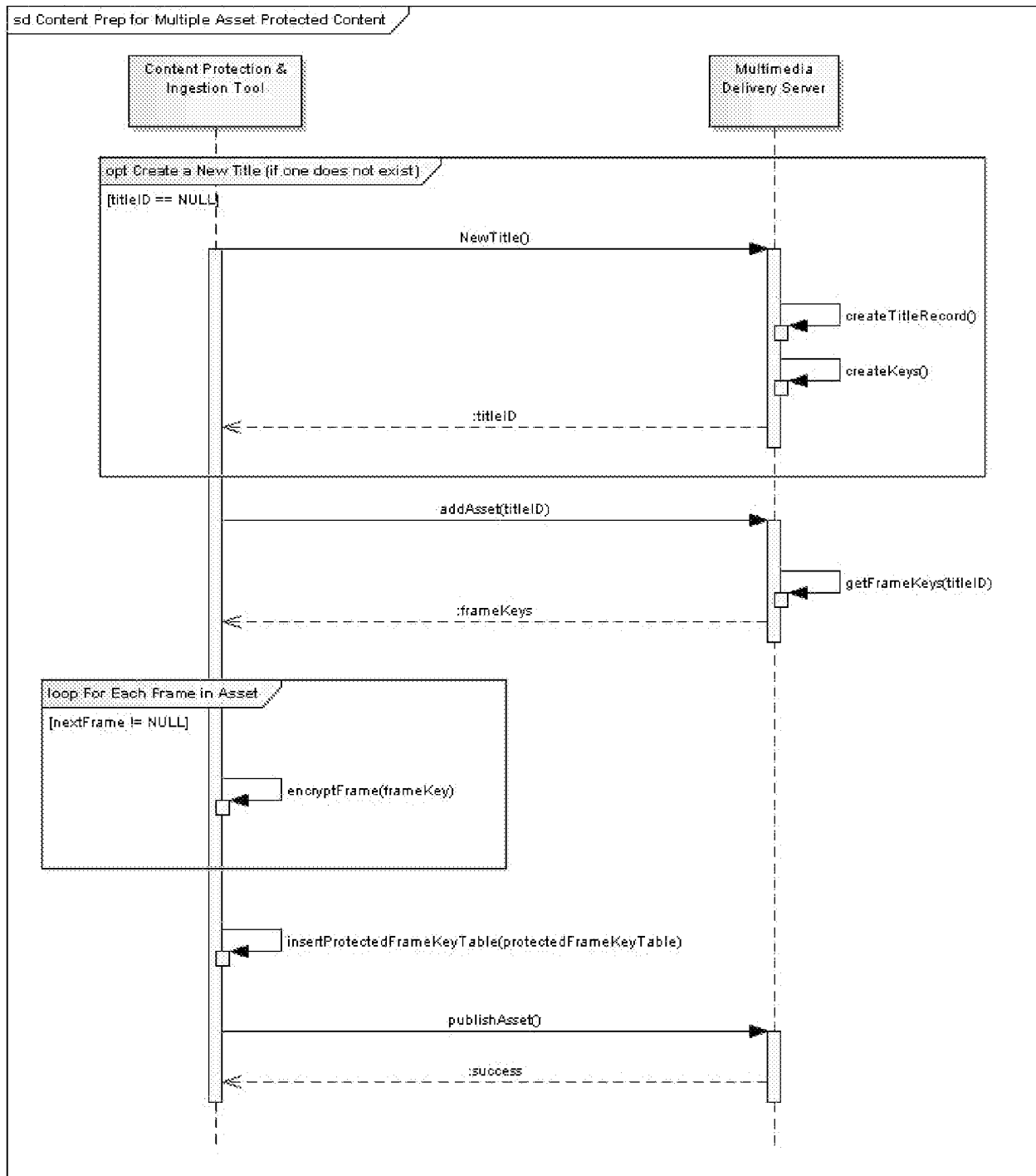


Figure 2

Figure 2 is a sequence diagram that shows the high level steps for protecting and ingesting an asset into a multi-asset protected content multimedia delivery system.

Another advantage to protecting all of the title assets within the same key space is that it facilitates the creation of a single multiplexed file based on the combination of various streams within the title. The

multimedia client delivery application is enabled to multiplex these assets or streams together and store them as one or more files based on the multiplicity of these assets. This enables the multimedia content delivery application the ability to store a title locally in a single portable container for a variety of reasons such as consumption at a later date/time, delivery of the title to other content delivery applications, as well as a variety of other purposes.

Multiple Asset Content File Structure:

The general file structure used for multiple asset content is multiple MKV files referenced by the top level index file, a SMIL file or manifest. For the system to allow for seamless video stream switching the frame keys used across the different MKV files are the same. The Tracks Data Payload will be duplicated across the files so that no matter which file is chosen on start-up the DRM information(frame keys) is available. This means the Tracks Data Payload is identical across the MKV files referenced by the top level SMIL file.

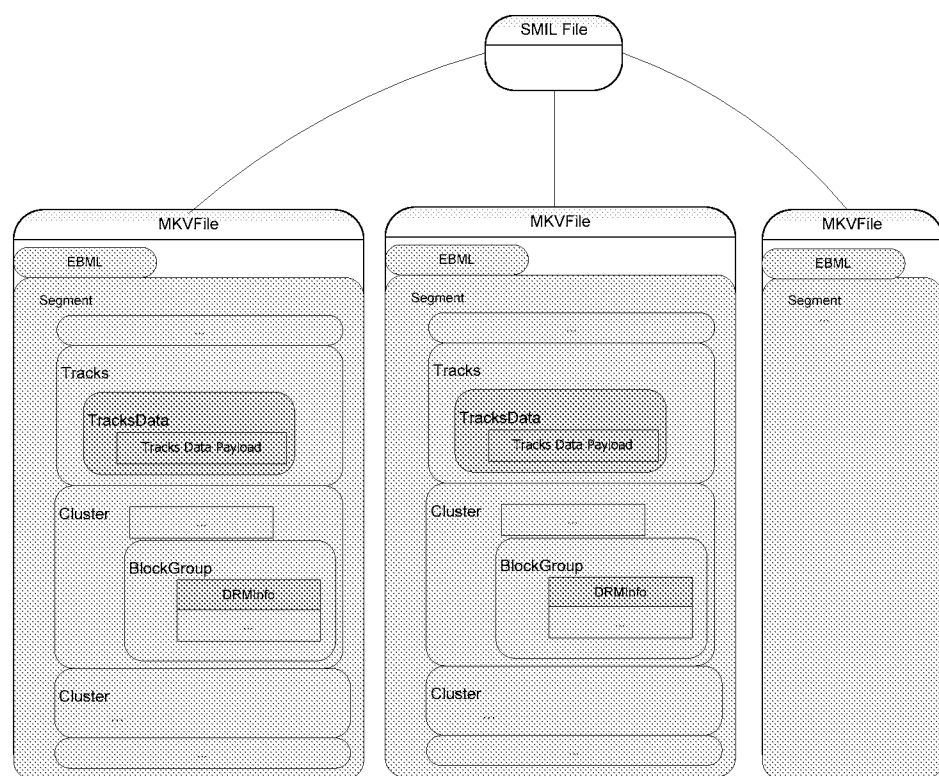


Figure 3

Figure 3 illustrates how the SMIL manifest refers to multiple MKV files that represent the multiple assets of the title. Each of these assets contain a DRM header in their Tracks Data block payload, that DRM header contains identical set of frame keys for each asset. The DRM header also contains a number of records or blocks of data that are both protected and unprotected data and that depends on the protection scheme being deployed for the particular title. The only content of the DRM header that is inserted at time of content preparation is the Frame Keys Record.

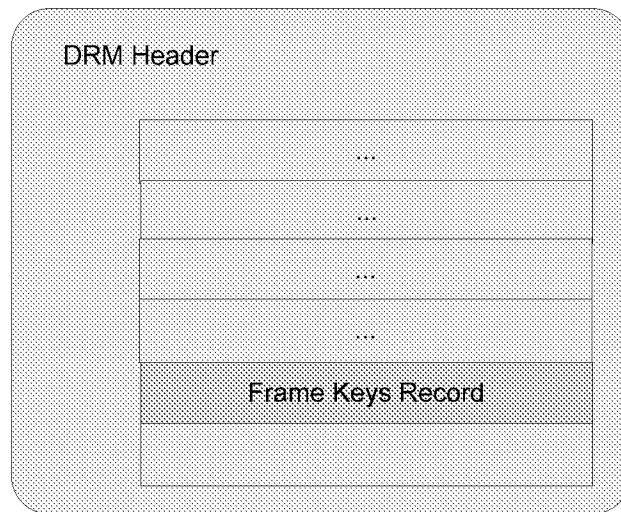


Figure 4

Figure 4 illustrates the DRM header structure. Within the DRM Header there are many blocks of data that carry information about the license and other protection specific data. The Frame Key record is inserted into the assets file structure by the content protection and ingestion tool. This frame Key record consists of the frame key table that is protected or encrypted by the session key.