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Web Audio/Video Streaming Tool

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ABSTRACT

In order to promote NASA-wide educational outreach program to educate and inform the public of space exploration, NASA, at Kennedy Space Center, is seeking efficient ways to add more contents to the web by streaming audio/video files. This project proposes a high level overview of a framework for the creation, management, and scheduling of audio/video assets over the web. To support short-term goals, the prototype of a web-based tool is designed and demonstrated to automate the process of streaming audio/video files. The tool provides web-enabled user interfaces to manage video assets, create publishable schedules of video assets for streaming, and schedule the streaming events. These operations are performed on user-defined and system-derived metadata of audio/video assets stored in a relational database while the assets reside on separate repository. The prototype tool is designed using ColdFusion 5.0.

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1. INTRODUCTION

In an effort to promote NASA-wide educational outreach program to educate and inform the public of space exploration, the web is emerging as powerful medium, in addition to existing NASA TV Channel. With rapid advances in audio and video technologies, NASA at Kennedy Space Center (KSC) is actively seeking efficient ways to add more contents to the web by encoding and streaming audio/video files. Currently, the process of Web audio/video streaming at KSC is done manually. Audio/video files are selected and copied to a folder. A scripted program, executing at every fifteen minutes interval, migrate the files to the edge servers for streaming. There is no capability to manage, browse and query the audio/video assets repository, and to produce reports of streamed items. Live feeds of special events from encoders have to be setup manually for web streaming. A framework to support NASA outreach program via the web is highly desirable. A web-based tool to manage the audio/video asset, to create and schedule publishable streaming program is necessary to meet the short-term goals.

The purpose of this project is to design a framework to support audio/video content creation, content management, content schedule and delivery via web streaming, and to demonstrate a prototype web-based tool to audio/video streaming. This tool will automate the audio/video streaming process at KSC. And establish a capability similar to NASA TV to deliver content via the web. The proposed framework, when fully established, will provide NASA with the capability to create and deliver content via the web at an enterprise level. The scope of this project is limited to a high-level overview of a proposed framework, and the design and implementation details of the web-based tool without any consideration of storage or video streaming technology.

This paper is organized as follows: KSC current web architecture is described briefly. A high level architecture of a proposed system is described, followed by a description of the system and functional requirements of the web-based tool to meet the short term need for content management, scheduling and delivery. Some implementation details are presented, followed by some concluding remarks

2. KSC Current Web Technologies

Figure 1, on page 3, shows an overview of current KSC technologies supporting its web services. Several web servers, ColdFusion Application Servers, video streaming servers, and a cluster of MS SQL servers are connected to a RAID repository system. All servers are connected in clustering mode with load balancing hardware. Currently, KSC supports video streaming only in Real Player format.

3. Proposed Framework

In order to meet KSC goal of utilizing the web to promote NASA-wide educational and public outreach content, a framework is proposed. A high level architecture of a proposed framework is shown in Figure 1. The model is derived from InfoSpaces [1], which describes a prototype for a large-scale content classification and dissemination network. The models are similar in terms of their abstractions but with different purposes. The challenges in [1] is the design of the scheduling algorithm for competing data-

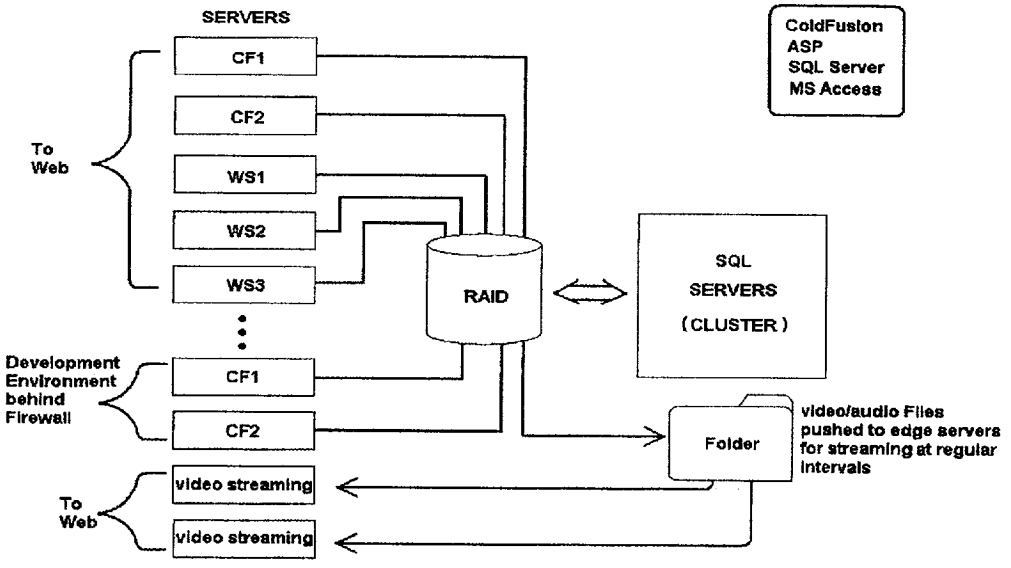

Figure 1. KSC Current Web Technologies

items over a limited number of heterogeneous delivery points. Like InfoSpaces, the proposed framework consists of three abstractions, which interact with each other through well-defined interfaces to provide the following capabilities over the Web:

1. Content Creation.
   - Web-based form interface to allow users to create and input content directly.
   - Information aggregator that uses pull mechanism to extract content from the Internet.
   - All application extensions to support content creation and extraction from the Internet have to operate within some form of security context

2. Content Management
   - Add/edit/delete "items" to content repository
   - Classify and queue "items" for approval
   - Maintain active "item set" for scheduling and delivery
   - Query content repository for report generations
   - Select items to create publishable schedules for streaming

3. Content Scheduling and Delivery
   - Time/Event triggered streaming of "items" of publishable schedules

4 Compatibility
   - Support multiple streaming format – MPEG –1, MPEG –2, MPEG –4, Real Media, Quick Time, Windows Media.
   - Support multiple delivery networks & protocols
   - Accommodate streaming of live feeds from encoders

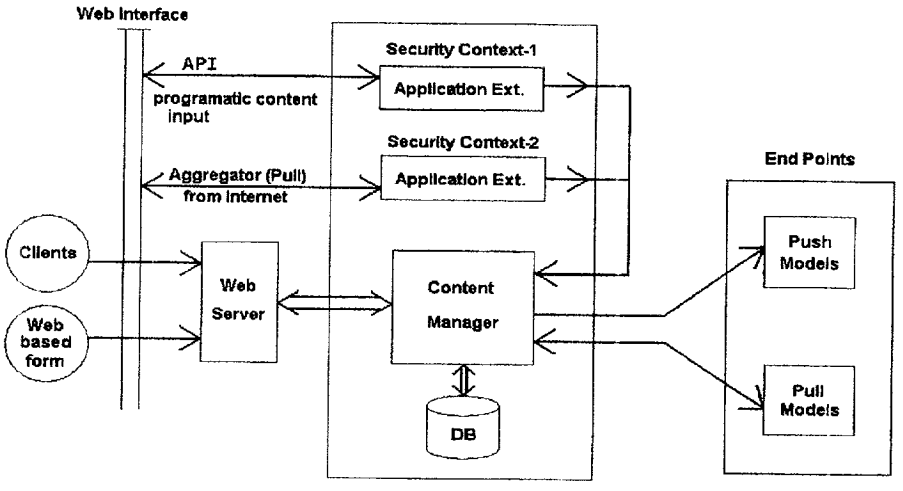

Figure 2. High Level Architecture of Proposed Framework

4. Database Server Support

Video files tend to be very large. Performing content management with the files directly would require costly storage requirements. Instead, metadata is used to describe, locate, fetch, and cache video objects for streaming. Metadata are user-defined and system-generated attributes, such as the name of a video object, physical characteristics (formats, size, bit-rate, etc.), rights associated with it, and the locations of the actual video object in the network. Using metadata provides several advantages in addition to reducing storage costs. All video attributes and URLs, regardless of their media format, can be mapped into a standard format of a database, rendering tracking, reporting, scheduling for streaming of video assets much easier. It can also help for caching items at edge servers for streaming.

Figure 3 shows the database schema, in MS SQL Server 7.0, for mapping metadata of video assets for content management. The Auth_users table holds user attributes to support a user authentication scheme with different user-level privilege. The Category table holds the different group of video asset and the Collections holds the attributes of the each asset in the repository. The Schedule table holds a record for each item set (scheduled list of item for time triggered streaming). The Schedule_Details table contains the itemized listing of each item set. The shows table is a log of all items that have been successfully streamed.

5. Requirements of Web-based Tool (short-term)

In order to meet the short-term requirement of KSC for automating the video streaming process, a web-based tool is proposed to facilitate the process. The tool should allow a nontechnical user to manage the video assets; select and schedule the activation of streaming files (in multiple formats), and to create

publishable schedule for the web. All operations should be performed through web-enable user interfaces that are driven by the back-end database holding the metadata of video assets. The set of permissive operations should depends on user-level privilege (ranging from administrator to user and guest). The functional requirements are:

1. Content Management:
   Add/Delete/Edit items
   Browse/Query items for reporting purposes

2. Schedule Management
   Create Schedules of item set for streaming
   Schedule publication of item set over the web
   Update schedules
   Schedule streaming of item set
   Provide status report to administrator of any malfunction

3. Administrative Tasks
   Add/Delete/Edit User Accounts & Privileges
   Access to Log Files

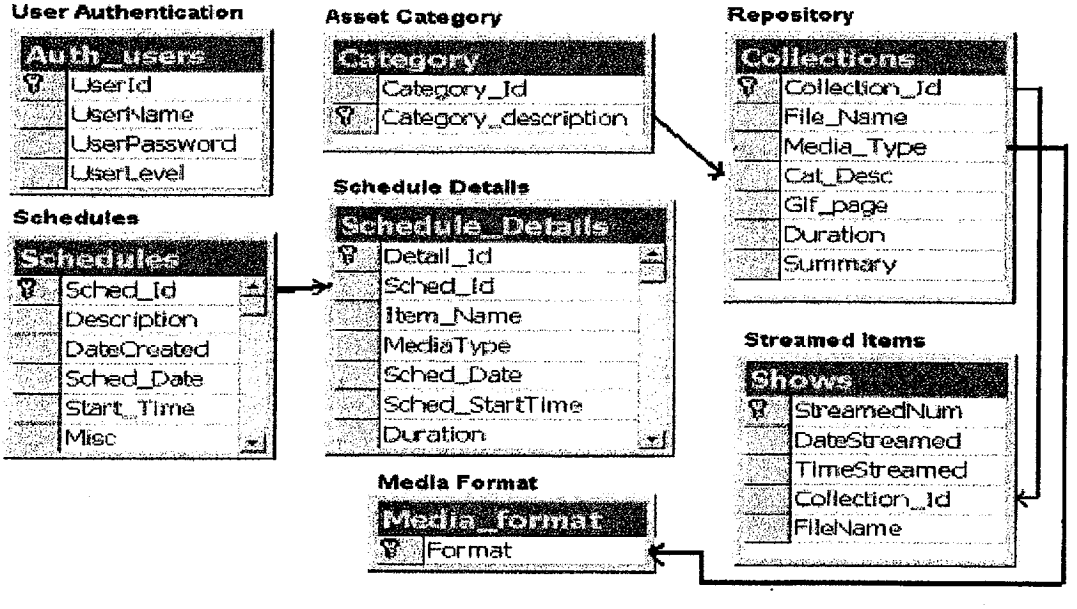

Figure 3. Database Schema of Metadata of Video Assets

6. Web Application Framework

The web application framework for the tool is designed using the features presented in ColdFusion 5.0 (KSC current web application servers) to logically group the CFML templates into a cohesive application capable of maintaining states, utilizing constants, handling exception and errors, and enforcing security. The Application.cfm and OnRequestEnd.cfm templates to provide these features [2], [3].

7. Development Technologies

The following technologies have been used to develop the prototype tool:

Operating Systems: Windows 2000 Advanced Server,
running MS-Internet Information Server 5.0, MS SQL Server 7.0, and ColdFusion MX.
Development Environment: Macromedia Dreamweaver MX.

8.CONCLUSIONS

A high-level framework to support the creation and management of video/audio assets is presented. A prototype for a web-based tool to automate the creation of publishable schedules, and the scheduling of the streaming process of audio/video files has been designed and demonstrated. A fully operational tool would require more robust user interfaces with additional functionalities, such as error handling and user-level customization. The problem of accommodating live feeds from encoders has yet to be solved. One solution would be to use Java threads with different priorities to handle scheduled streaming and live feed separately. However, this would require migration to ColdFusion MX. While the tool would support content management, scheduling and delivery of streaming video files, content creation within the proposed framework would require the development of application programming interface to input content directly into the system, and to support content integration from the Internet. Both should be operated within some security context. ColdFusion provides the necessary security framework for such development.

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