
Screening Room Technical Overview

A CONVERA White Paper





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SCREENING ROOM TECHNICAL OVERVIEW



Organizations of all types – from Fortune 500 corporations to network news agencies – need flexible, intelligent access to their video-based resources. Convera's Screening Room is the first video content management solution that lets you easily capture, manage, repurpose and publish your video content using a single system.

Screening Room is a client/server solution consisting of two major subsystems:

Screening Room Capture - ingest, metadata extraction and digitization

Screening Room Video Asset Manager - content storage, management, search, retrieval and repurposing

Screening Room Capture creates a thumbnail storyboard by analyzing analog or digital video to identify and classify major scene changes– cuts, fades, and dissolves – as well as salient scene events like pans, zooms and composite graphics. Encoded video files are simultaneously created and stored in video servers for Web browser access, on-line viewing or archival purposes. Additionally, Screening Room Capture creates structured and unstructured metadata - user annotations, clips, clip notes, frame notes, closed-captioned text and voice-to-text translations from the audio track.

Screening Room Video Asset Manager stores video assets using a folder metaphor in secure databases for easy visual navigation. The metadata created by Screening Room Capture is correlated to the storyboard and any number of encoded proxies with a precise time code. Other asset management functions include archival and retrieval of media through integration with hierarchical storage systems, maintenance and duplication of media and metadata and export of video assets to other databases.

Screening Room Video Asset Manager Applications

Screening Room Edit accesses and modifies storyboards and is used to define clips. To access a specific storyboard, users can browse the database, search storyboard related text for a specific word or phrase, or search for storyboard frames that are similar in appearance to a selected frame or other image. Users can assemble a rough-cut preview by selecting in and out points from any asset in the system and view the rough-cut immediately by playing the selected clips in any order. Projects can be organized in persistent bins or exported as Edit Decision Lists (EDL) for use with nonlinear video editors. The rough-cut can also be used to create new, higher value derivative assets.

Screening Room Browse provides widely distributed access to your Convera's Screening Room video assets via a desktop Web browser. Anyone with the appropriate access privileges can view storyboards and related information over the Internet, an intranet or an extranet. As with *Screening Room Edit*, the desired storyboard is chosen by browsing, by searching for specific text or by searching for frames that are similar to a selected frame.

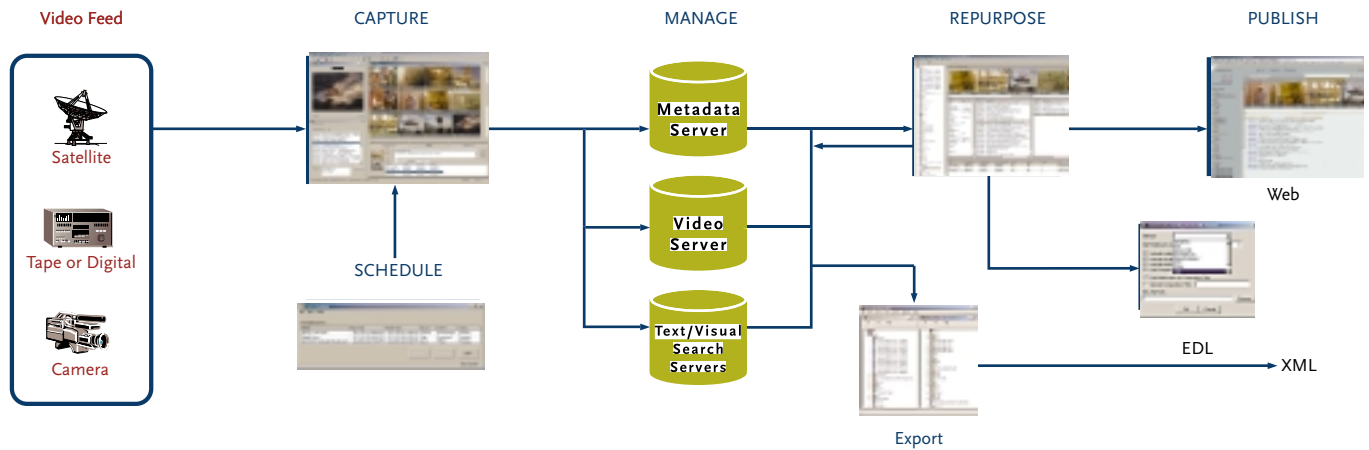
Screening Room Admin is an administrative tool for managing Screening Room's metadata fields, video servers and search servers.

Screening Room Exporter is a utility program for importing and exporting metadata and video in and out of Screening Room systems and file system directories using XML.

Screening Room features and benefits include:

- Ability to capture, manage, repurpose and publish analog or digital video asset for quick, easy and affordable use and re-use. Fast, immediate access to film and video libraries on existing corporate Intranets.
- Dramatically reduce and even eliminate the time wasted in previewing video content in expensive offline and online edit bays. New programming can be created in shorter production cycles.
- Leverage the corporate repository of footage for projects and presentations. Assemble and view a rough-cut preview right on the desktop.
- A broad range of integrated knowledge retrieval tools including Boolean morphology, concept and pattern searching combined with Screening Room's visual image matching give users a variety of powerful options to retrieve and locate video assets.
- Supports standard interfaces, APIs and other industry standards including XML, ODBC and COM/DCOM.

This diagram illustrates the high-level system architecture and maps some of the Screening Room features to specific components in a typical workflow/dataflow



CAPTURE ANY ANALOG OR DIGITAL SOURCE:

- Satellite
- Tape Deck
- Digital File
- Camera Feed
- Streaming Media

SCREENING ROOM CAPTURE

- XML Based Video Logging
- Full Configuration Wizard
- Schedule Management
- Device Control
- Industry leading Video Analysis
- Storyboard Creation
- CC/Teletext Extraction
- Speech Recognition
- User Definable Fields
- Clip Creation/Annotation
- User Definable Frame Metadata
- Distributed Encoding
- Encode WM, REAL, QT, MPEG1, MPEG2,
- Video File Distribution Mgmt.

SCREENING ROOM ADMIN + VIDEO ASSET SERVER

- Database Integration
- Video Server Integration
- Convera's RetrievalWare Index
- Administration Client
- Distributable Components
- Set Fields Viewable/Hidden
- Set Fields Edit/No Edit
- Custom Database Fields
- Visual Search

SCREENING ROOM EDIT

- Desktop Client
- Create/Edit Folders
- Create/Edit Clips
- Create/Edit Metadata
- Create/Edit Frame Metadata
- Natural Language Query
- Fielded Database Search
- Image Matching Query
- Video Proxy Playback
- Play List Creation
- EDL Creation
- Derivative Asset Creation

SCREENING ROOM BROWSE

- Browser Interface
- View Folders
- View Clips
- View Metadata
- View Frame Metadata
- Natural Language Query
- Fielded Database Search
- Image Matching Query
- Video Proxy Playback
- View Play List

FIGURE 1. HIGH-LEVEL SYSTEM ARCHITECTURE

The main components of Screening Room Video Asset Manager are Convera's Text Search Server (RetrievalWare), Convera's Visual Search Server (CSTS – Color / Shape / Texture Server), a relational database and a video server. An archive manager interfaces to optional near-line storage systems. Screening Room clients talk to a set of client side modules that communicate with the servers.

C L I E N T S I D E

<i>SRQuery</i>	Screening Room Edit and Screening Room Browse access this component for text searching. SRQuery wraps the RetrievalWare C API and abstracts that subsystem's complexity from Screening Room clients.
<i>VAC2XML</i>	VAC2XML wraps Screening Room SQL database queries and converts results to XML.
<i>VideoClip Presenter</i>	Screening Room Edit and Screening Room Browse use this component for video proxy playback. VideoClip Presenter constructs and previews a custom video playlists comprised of video in any supported format.
<i>Attachment Manager</i>	Screening Room Edit and Screening Room Browse use this component to manage such functions as copy, move, delete, rename, chop, archive, retrieve and index video proxies.

S E R V E R S I D E

<i>Database</i>	Relational database with ODBC connections
<i>Video Server</i>	Streaming video server – WMT, REAL, QuickTime, etc.
<i>Video Media Server</i>	Manages video file operations - index, asfchop, etc.
<i>CST Server</i>	Color/Shape/Texture image matching server
<i>RetrievalWare</i>	Natural language search servers
<i>Data Mover Dispatch</i>	Controls the movement of data via FTP
<i>Archive Manager</i>	Interface to a variety of Hierarchical Storage Management (HSM) systems

This diagram depicts a moderately detailed view of the Screening Room system architecture. Modules are displayed as applications, client side components or server side components.

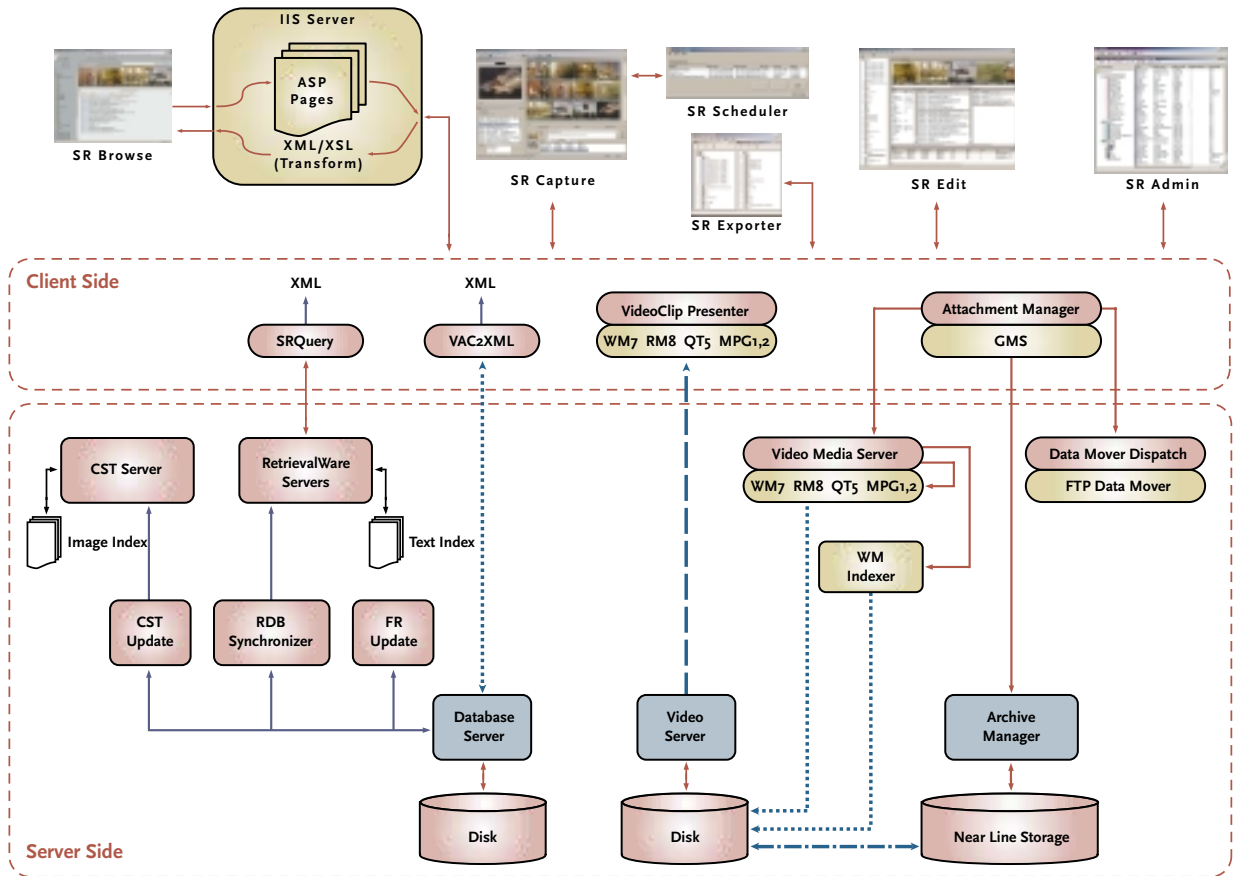


FIGURE 2. SCREENING ROOM ARCHITECTURE DIAGRAM



Screening Room Capture consists of a Capture Server and set of applications to configure the capture, creation, logging, scheduling, processing and distribution of video and video metadata. Screening Room Capture configuration, processing and distribution are administered through the Screening Room Capture Server Wizard. An API is available for integrating and customizing applications to control the Screening Room Capture Server. Video can be input from a variety of analog and digital sources and processing can include any or all of the following:

- Metadata Capture: Video-event detection (scene change), text capture (closed captioning and speech-to-text), manual and automatic annotation at various levels.
- Encoding: one or more digital copies of the input video, in various formats and at multiple bit rates, for later viewing and real-time repurposing.
- Metadata Consumption: the results of video analysis and text extraction, and all related information—the metadata or “CaptureData”—are written to XML files. This captured data then can be simultaneously posted to a database server, transmitted to Web servers, copied to storage and so on.
- Video Distribution: the encoded digital-video file(s) can be transferred to video servers, duplicated, archived, etc.

Screening Room Capture controls four primary *manager* components.

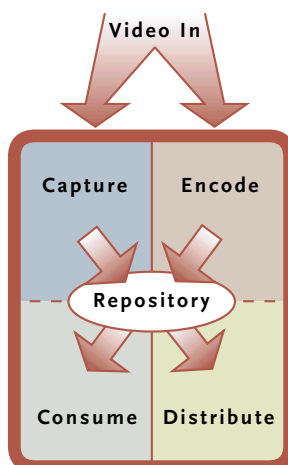


FIGURE 3. SCREENING ROOM CAPTURE CONTROLS

Capture Manager – Capture is primarily responsible for controlling automated and manual processes that create metadata about the video being acquired. Automated processes include the detection of video scene changes, detection of video markers such as black frames, extraction and correlation of time code, text extraction, audio track transcription using speech recognition, creation of log files and device control. Manual operations include entering the storyboard label, notes fields and user-definable fields as well as defining and annotating clips and key frames. Capture produces the *CaptureData* repository; a directory structure that records all metadata generated each session. Each *CaptureData* directory is named with a unique date/time stamp.

Consumer Manager – Consumer Manager processes the *CaptureData* according to instructions in each Consumer configuration. One consumer might commit the *CaptureData* into a Screening Room database while another posts the *CaptureData* to a website. You can enable and configure multiple versions of the same consumer.

Encoder Manager - Encoder Manager administers encoders, which digitizes the input video to produce a copy of the input as a digital video file or stream in a specific format. Each encoder uses an audio-video input source and can be installed on machines other than the Screening Room Capture host for distributed encoding. In addition, you can configure multiple copies of a particular encoder to produce digital-video files of the same format with different playback characteristics.

Distribution Manager – Distribution Manager coordinates distribution of the digital video files produced by the encoders. An example of a distribution task is transfer of video files to a Screening Room Video Server. An encoded file can be transferred to multiple destinations. The Distribution Manager supports FTP and direct-write operations and will perform selected processing tasks (i.e. file indexing or archiving) either before or after distribution.

Screening Room Capture Applications

Screening Room Capture Wizard consists of five primary sections—a section for setting general application parameters, and one each for the four manager components. You can engage the wizard at any of the five major sections. Each configuration is saved in an XML-formatted file to allow different users to operate the same Capture Server or allow the same operator to easily switch to an alternate configuration. In addition to configuring key subsystems (i.e. WMT or REAL encoders), the wizard includes test facilities to ensure proper configuration prior to usage. A Status Window displays the health of the components in operation and during the metadata consumption and encoded file distribution stage.

Screening Room Scheduler is a companion application to Screening Room Capture that is used to set up the capture of analog-video input automatically at specified times. This is particularly useful with regularly scheduled programming, such as the nightly news from a satellite feed. Screening Room Scheduler is a separate application that can control multiple Screening Room Capture installations, both local and remote. XML configuration files that specify all session details are loaded for each scheduled event. These configuration files can be created by the Screening Room Capture Wizard, manually edited or generated by a calling application. The results of a scheduled event are committed to a Screening Room system, posted to a file/web server or written to a

third-party asset manager. Any combination of these consumption options is specified in the XML configuration file. The different metadata fields associated with each capture are read by the Consumer Manager directly from the destination to allow the capture operator to optionally preload all metadata fields for each event prior to capture.

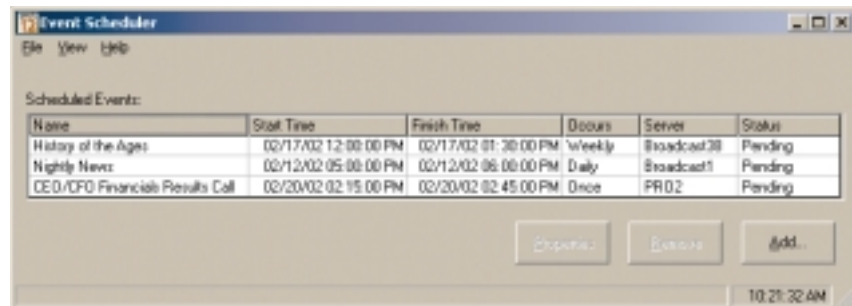


FIGURE 4. SCHEDULER DIALOGUE BOX

Convera's Video Analysis Engine

One of the lower level components of Screening Room Capture is the Convera's Video Analysis Engine (VAE). VAE - implemented as a transform filter for a Microsoft DirectShow filter graph - provides extensive control over the scene change detection processing and can discriminate between cuts, fades and dissolves. Upon notification of a scene change being detected by VAE, an application typically posts a time-correlated thumbnail that visually displays the change to an end user. Screening Room includes an icon to denote the type of scene change as well as an image. In addition to detecting scene changes, VAE includes a unique algorithm for selecting frames that represent the action occurring within a clip. These summarization frames are called *salients*. Salients are based on things like pans, zooms, tilts and video content changes. All VAE events are detected by using advanced pixel-level processing techniques proprietary to Convera. The control mechanism includes multiple levels of abstraction to shield end users from the more technical components. At the simplest level, VAE provides a set of predefined genres to automatically set system parameters. These genres are drama, sports, news, commercial, documentary, animation and custom. The next level is a simple slider bar to increase or decrease sensitivity. Advanced users can control event detectors directly.

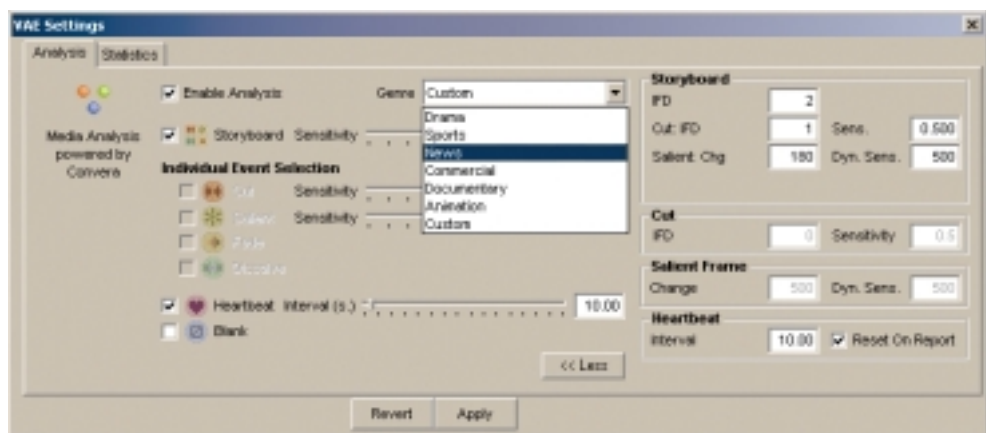


FIGURE 5. VAE SETTINGS DIALOGUE BOX

The following shows the Screening Room Capture Architecture with its main components. Screening Room Capture uses Component Object Model (COM) for same-machine processes and Distributed Component Object Model (DCOM) for machine-to-machine process communication. DCOM is a protocol that enables software components to communicate directly over a network in a reliable, secure manner.

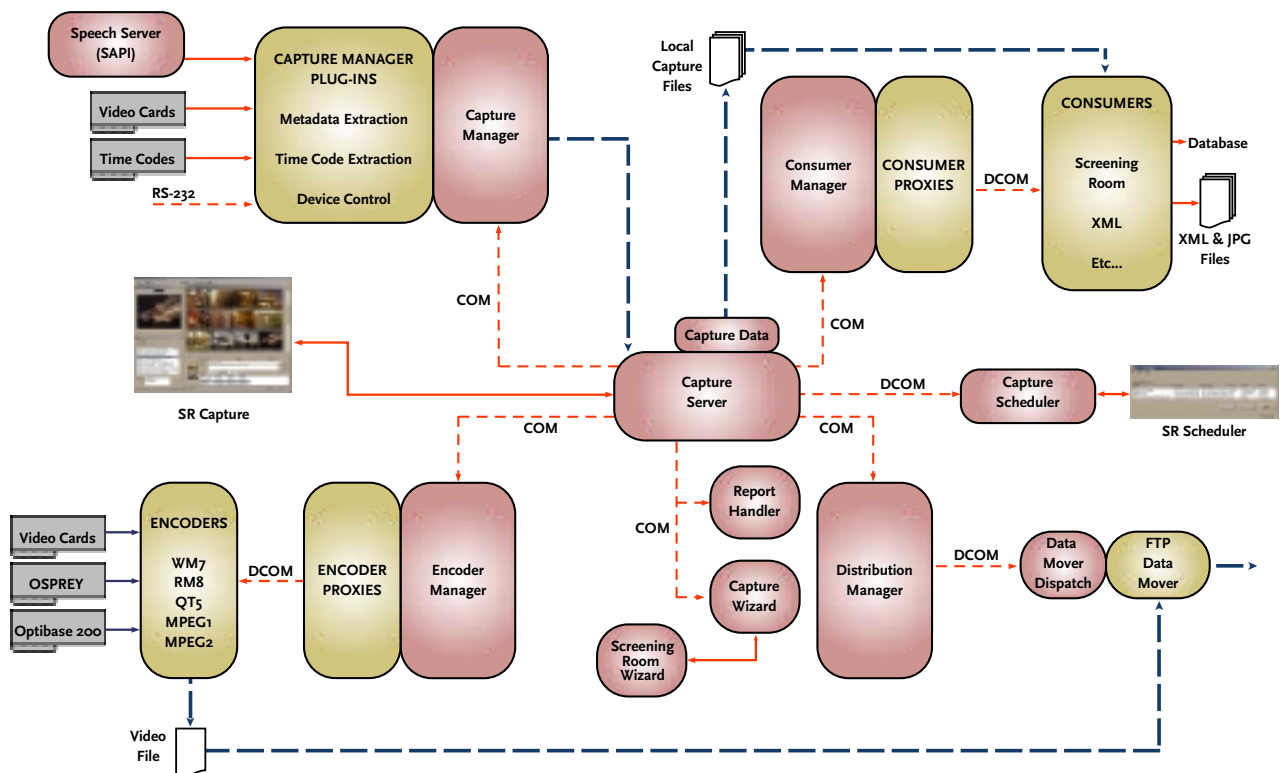
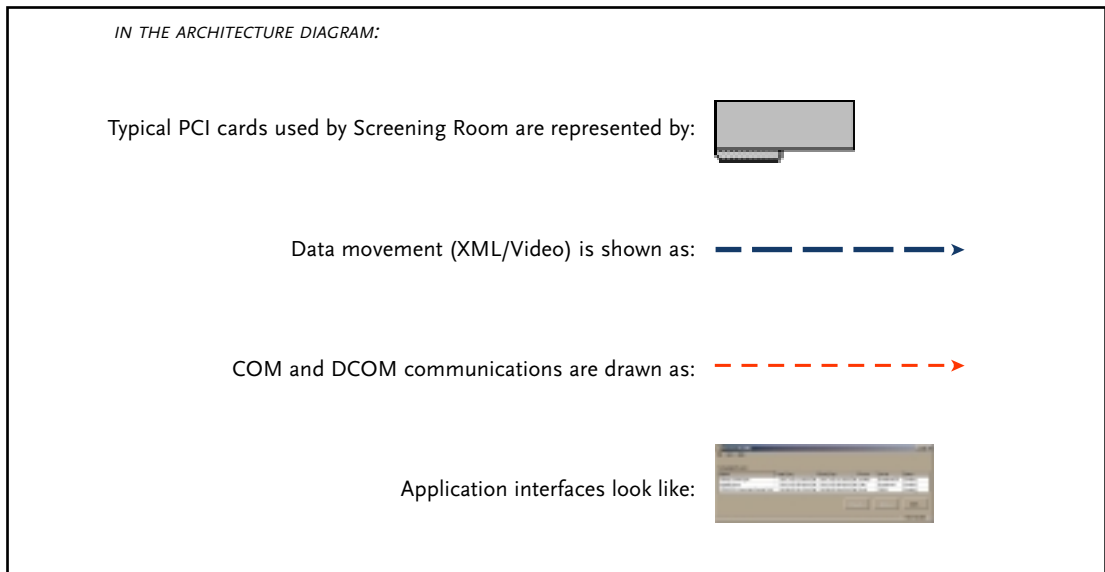


FIGURE 6. SCREENING ROOM CAPTURE SERVER ARCHITECTURE

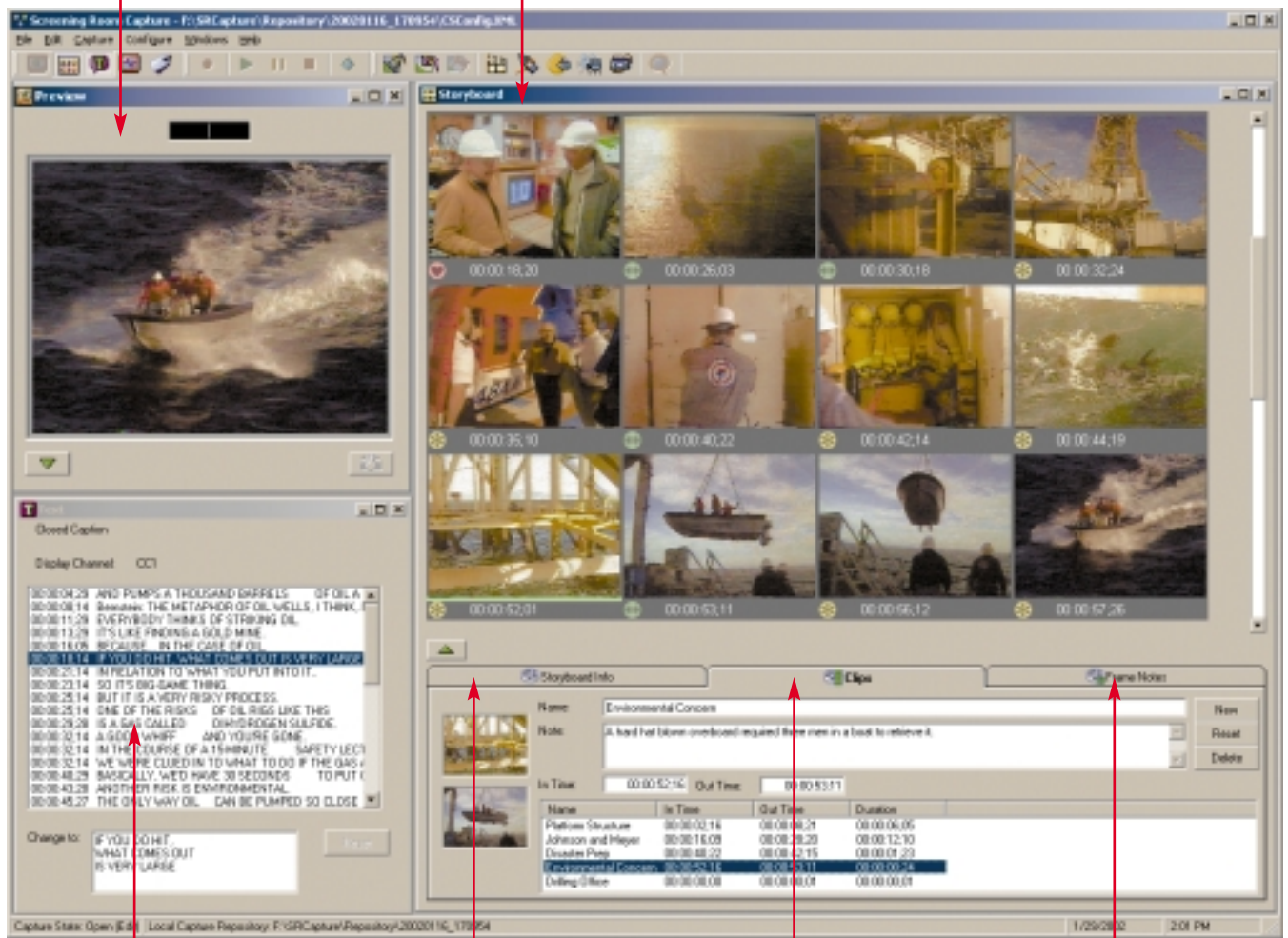
The Screening Room Capture interface is a Visual Basic application with MDI or Multiple Document Interface behavior. A typical interface layout is shown here with the Video Preview Window, Storyboard Window and Captured Text Window displayed.

The Preview window displays the input video being passed to the Capture Engine for processing (e.g., video analysis and text extraction).

The Storyboard displays frames that correspond to real-time event detection in the video. Convera's Video Analysis Engine is capable of detecting CUT, FADE, DISSOLVE, SALIENT and BLANK frames. A heartbeat can be configured for interval-based key framing and users can manually grab any frame. VAE also locates faces in each storyboard frame. An icon displayed with every frame denotes its video event type.



cut fade dissolve salient blank heartbeat snapshot face



The Captured Text window presents the text being extracted via Closed Captioning or transcribed by speech recognition during a capture. You can edit this text on a line-by-line basis.

Storyboard Info tab is used to enter the storyboard name and a full description.

Clips tab is used to define and annotate clips in real-time or after the capture.

Frame Notes tab is used to attach text to individual frames. Select any storyboard frame and enter text or attach a file.

FIGURE 7. THE SCREENING ROOM CAPTURE INTERFACE



SCREENING ROOM EDIT



Screening Room Edit is a Visual Basic application with Multiple Document Interface (MDI) behavior that lets users access, modify and delete the video asset descriptions (storyboards and metadata) and encoded video files constructed and stored by Screening Room Capture. Screening Room Edit displays storyboard frame images, along with time codes, annotations, and captured text and you can view any related digital video files. You can also create and edit clips, perform text or image searches, export edit decision lists (EDLs) and produce new, derivative video assets from existing clips.



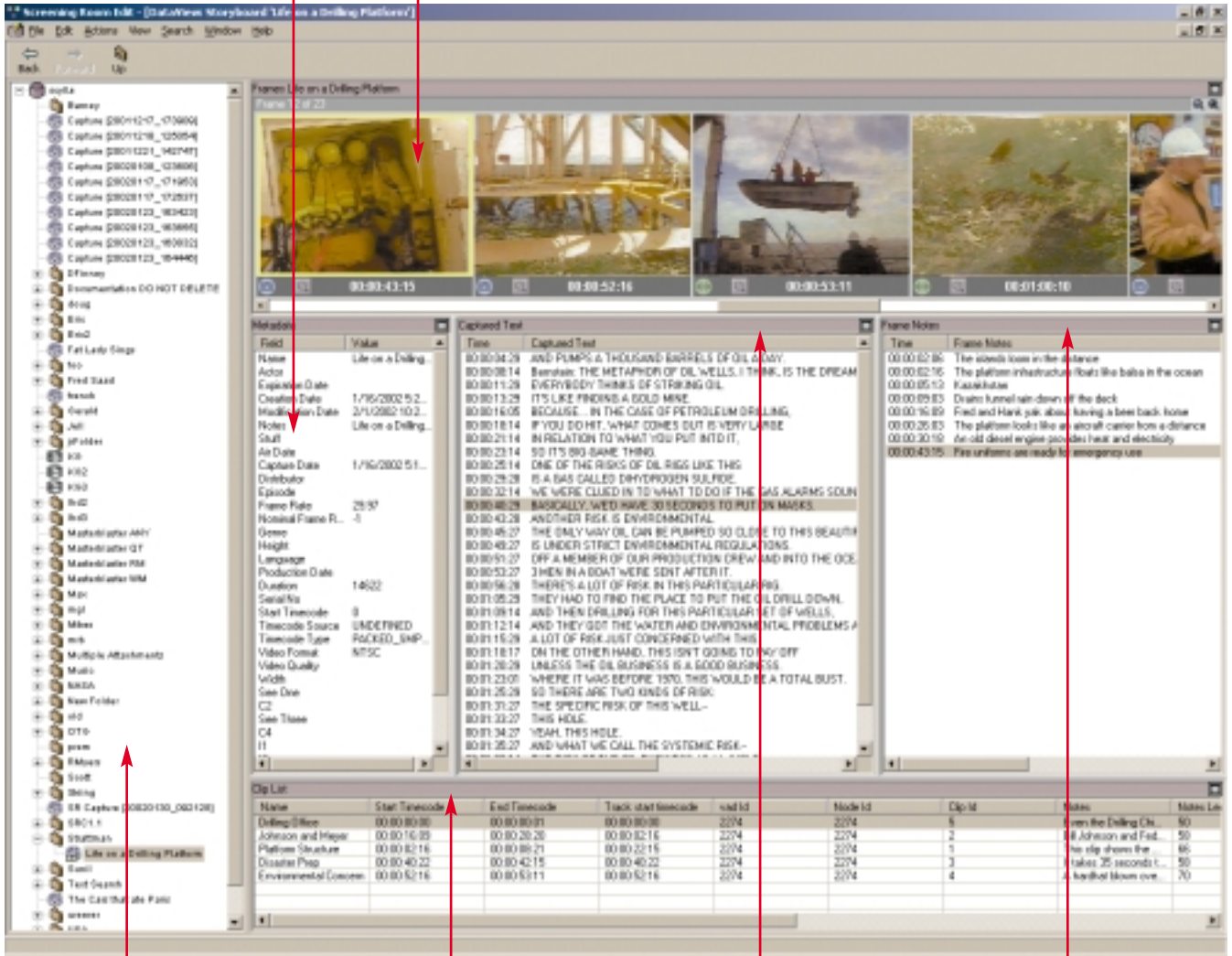
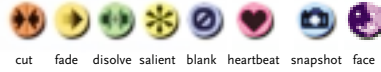
Screening Room Edit can connect to and display data from any number of Screening Room installations or Data Sources. Connections are established using Microsoft® Data Access Components (MDAC). Specifically, users select one or more Data Source Names that are pre-configured to use an ODBC connection to a relational database. All currently connected Data Sources are displayed in a tree view. Screening Room Edit supports some operations across all selected Data Sources such as name search or image matching. Since each Screening Room database may have different metadata fields, RetrievalWare searches are performed against the currently selected Data Source. Other operations, like moving storyboards and video from one Data Source to another are handled by the Screening Room Exporter utility program.

Screening Room Edit includes Convera's Video Clip Presenter (VCP) to allow users to construct and preview custom video playlists comprised of video in any supported format. For example, users can assemble a playlist with Windows Media, Real and QuickTime video clip in the same BIN and use Video Clip Presenter to view the result.

The following page shows a screen capture of Screening Room Edit.

The Storyboard displays frames that correspond to scene changes in the video. An icon displayed with every frame denotes its video event type.

Metadata displays database fields



Video assets are organized in folders. The tree view allows access to an asset through manual browsing. Text and image searches in Screening Room Edit position the user to the exact location in the hierarchy.

Clips lists define clips by name with in and out time codes. Mousing over the in or out time code positions the storyboard to the associated frame.

Captured Text shows CC and speech-to-text output. Mousing over the time code next to any text line positions the storyboard to the associated frame.

Frames shows all frame notes. Mousing over the time code next to the note positions the storyboard to the associated frame.

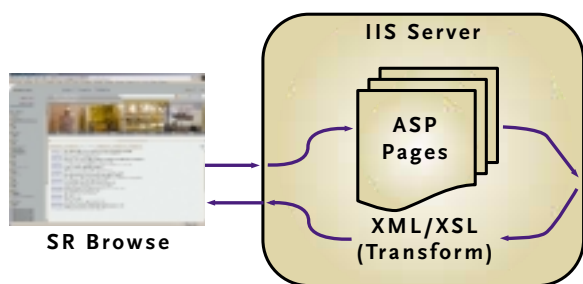
FIGURE 8. SCREENING ROOM EDIT



SCREENING ROOM BROWSE



The Browser Client is a combination of server-side IIS Active Server Pages, and client-side (browser) Dynamic HTML script. The ASP files provide the central power of the server, and leave the browser “thin” to run on various platforms. The DHTML scripts provide application-like features that make user navigation powerful, while distributing that processing to the client. Screening Room uses the IIS server starting with a default ASP page. From there, calls are made to two main components for accessing Screening Room data and functionality. *Refer to the Screening Room Architecture diagram on page 6.*



The first component is SRQuery. This component shields web developers from having to learn the RetrievalWare family of servers. All of the calls needed to search, rank and return hit lists from Screening Room can be accessed through ASP pages designed to interface to SRQuery.

VAC2XML abstracts all of the database access functions. Web designers don't need to know SQL to list all Screening Room folders or assets, display storyboards or browse metadata fields.

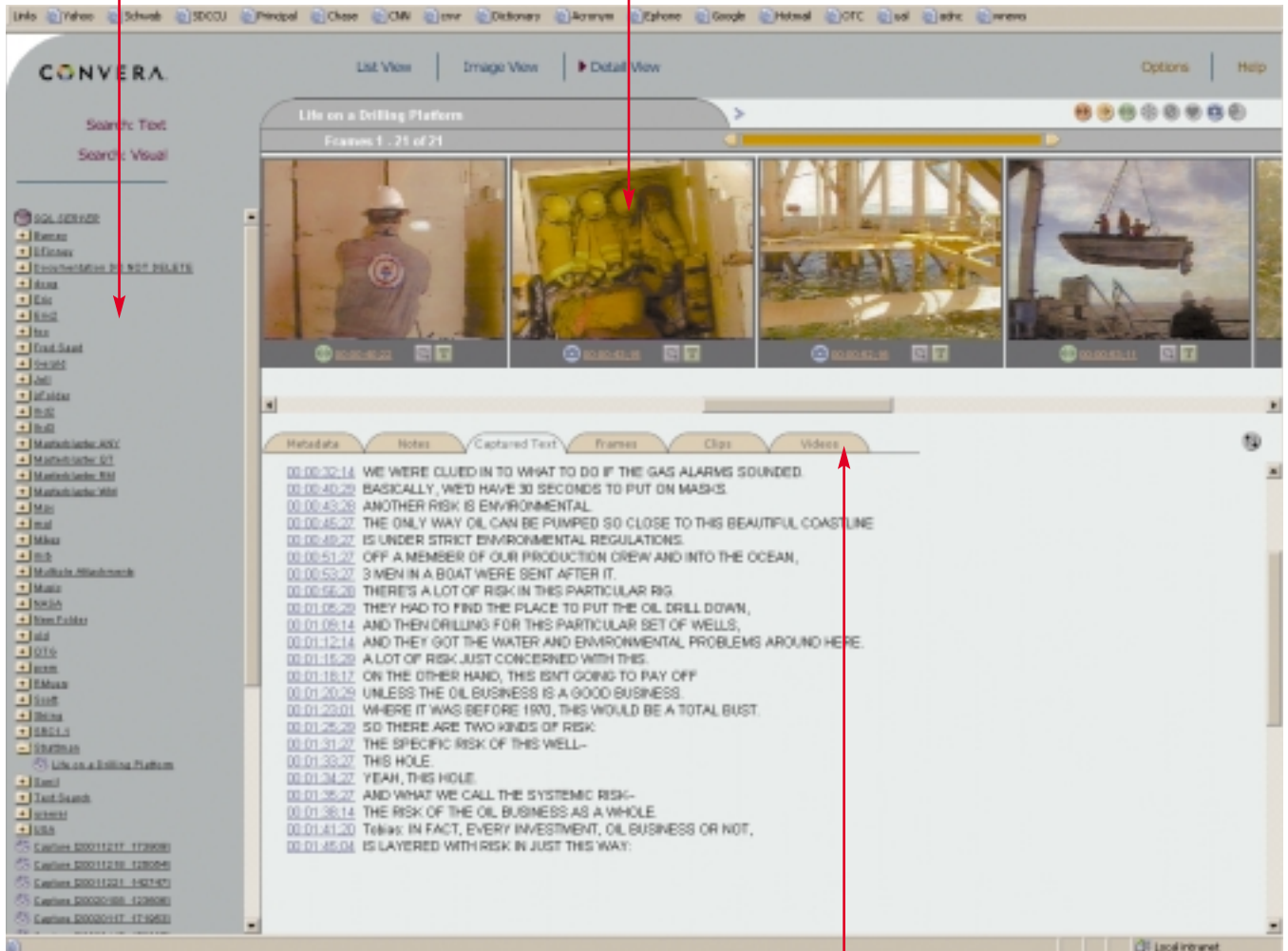
FIGURE 9. SCREENING ROOM BROWSE

These components send XML back to IIS to be transformed with an XSL style sheet into DHTML and sent back to the browser

The following page shows a screen capture of Screening Room Browse.

Video assets are organized in folders. The tree view allows access to an asset through manual browsing. Text and image searches in Screening Room Browse position the user to the exact location in the hierarchy.

The Storyboard displays frames that correspond to scene changes in the video. An icon displayed with every frame denotes its video event type.



Six tabs in the center of the browser window can access all of the detailed metadata about a video stored in Screening Room. The Captured Text tab is currently selected.

- Metadata** displays database fields
- Notes** displays an abstract about the currently selected video
- Captured Text** shows CC, Teletext or speech-to-text output – mousing over the time code next to any text line positions the storyboard to the associated frame
- Frames** shows all frame notes – mousing over the time code next to the note positions the storyboard to the associated frame
- Clips** lists defined clips by name with in and out time codes – mousing over the in or out time code positions the storyboard to the associated frame
- Videos** lists all encoded video files associated with this video asset – a typical list would show WM, Real and QT format video available

FIGURE 10. SCREENING ROOM BROWSE



SCREENING ROOM ADMIN



Screening Room uses an administrative component – Screening Room Admin - that can be used to configure or reconfigure an installation. Most of the configuration options are located in the metadata server (RDBMS) while some other items are stored in the registry of the specified host system.

This component is a static node snap-in and a set of extension snap-ins for Microsoft Management Console.

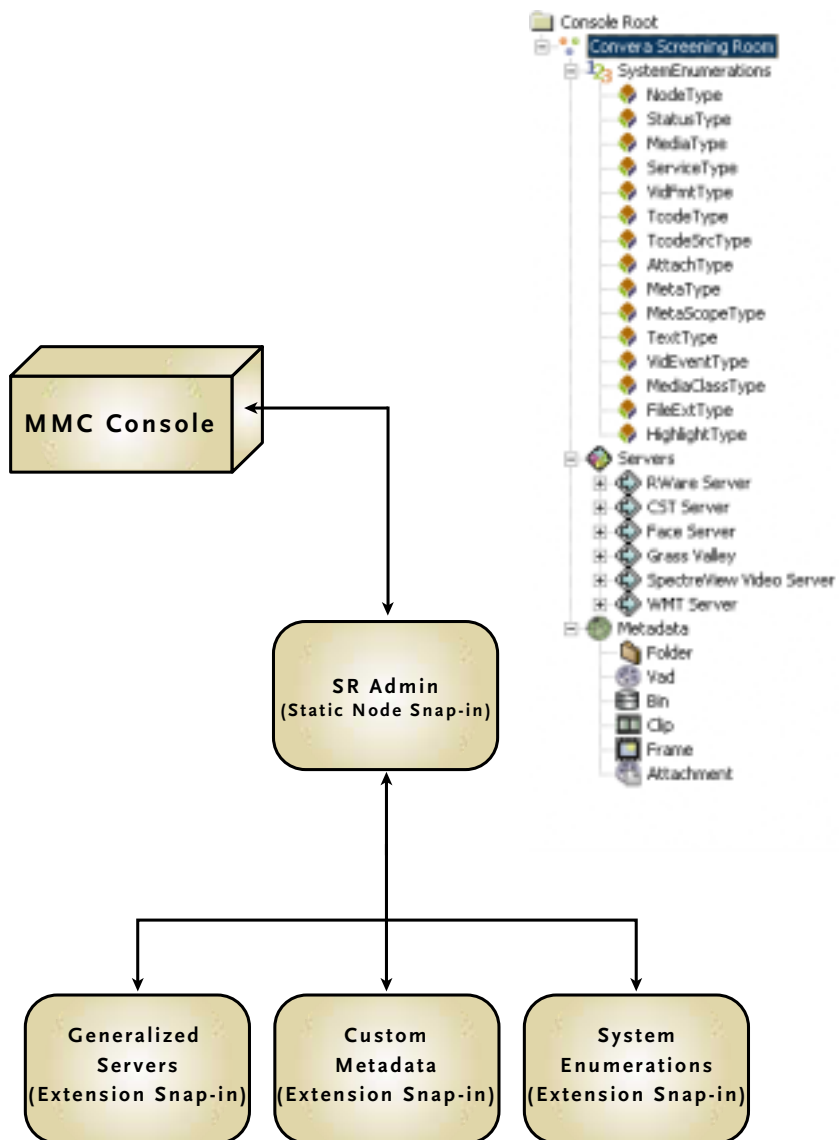


FIGURE 11. SCREENING ROOM ADMIN



Text Searching

Screening Room's integration of Convera's RetrievalWare supports indexing and query of the textual content of assets from Screening Room Browse and Screening Room Edit. An asset in Screening Room is really a node - storyboards, bins and folders - stored within a database. The textual content of the node includes metadata, notes and captured text. For each node, this textual content forms a virtual document that is indexed by RetrievalWare. While the contents of the virtual documents are stored as records within a relational database, RetrievalWare maintains the index on these documents externally and automatically.

A component called SRQuery is used by Screening Room client applications to perform text queries. The document hits returned by SRQuery are in XML format. Clients such as Screening Room Browse can then apply XSL style sheets to the XML to affect display. SRQuery is a wrapper around the RetrievalWare "C" API.

Screening Room provides three primary text search types: Concept, Pattern and Boolean.

Concept

In Concept mode, queries are entered in "plain" English with no operators and Screening Room automatically performs semantic expansion on all query terms, meaning the search returns include conceptual matches. For example, a query for "star" might return references to an actor in a leading role, as well as a bright object in the night sky. Query wildcard characters can be used in Concept searches.

Pattern

In Pattern mode, queries are also entered in "plain" English with no operators, but Screening Room tolerates spelling differences, meaning query terms produce matches with words that are spelled similarly. For example, the misspelled query "Kazeckistan" will match to "Kazakhstan." This is particularly useful when searching for technical terms and proper names and places. Automatic pattern expansion is performed on all query terms. Query wildcard characters cannot be used during Pattern searches.

Boolean

Boolean mode uses traditional Boolean operators to produce exact matches. There is no automatic expansion, and query entry is more rigid in that the Boolean operators and correct syntax are required. Searching is faster than with the other

two modes, but you must sift the returns yourself. The Boolean operators are AND (&), OR (|), NOT (^), WITHIN, ADJ, and BUT. The AND operator is the default; that is, if you enter two terms with no operator between them, AND is assumed and both terms must be matched to effect a return. Query wildcard characters can be used in Boolean searches.

Query Wildcard Characters

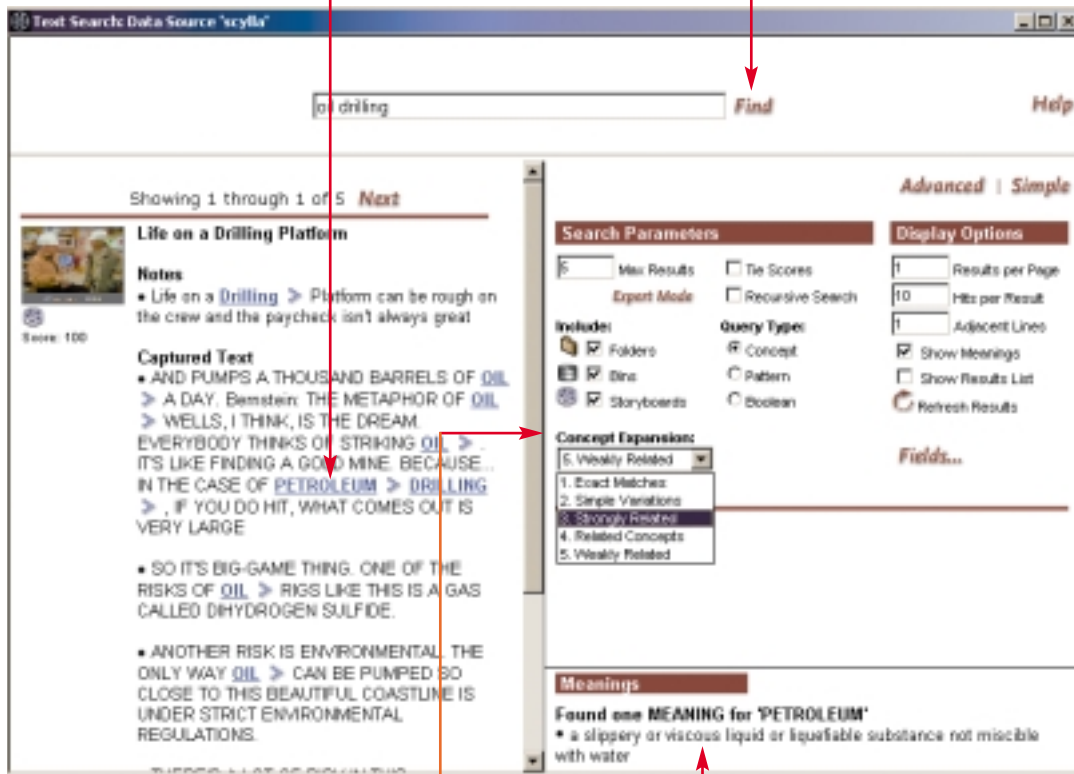
Wildcard characters can be used in queries in place of unknown characters and to search for multiple variations of a term. Wildcard characters can be used in Concept and Boolean searches, but not in Pattern searches. The available wildcard characters are:

Wildcard	Description	Example
*	Match anything or nothing.	pharma*
?	Match exactly one character.	la?er
_	Match one or no character.	colo_r
@	Match exactly one alphabetic character.	c@er
#	Match exactly one numeric character.	#600
\	Take the next character literally; i.e., not as an operator.	joe\@home
^	Match any character except the next one.	199[^7]
[]	Search expression; can include a hyphen to indicate a range of letters or numbers; will match only one character in the brackets.	199[1-5,8]

The following page shows a screen capture of Screening Room text search using natural language (Concept) query mode.

A click on the highlight results
display the storyboard thumbnail
image corresponding to that point
in the video. Play the video from
here or open up the full video asset

Natural Language Search



Concept Expansion provides five levels of query term expansion:

- Exact Match
- Simple Variations
- Strongly Related
- Related Concepts
- Weakly Related

PETROLEUM DRILLING matched to the clue string "OIL DRILLING" using RetrievalWare's natural language searching

FIGURE 12. SCREENING ROOM TEXT SEARCH

Image Searching

Screening Room's Color/Shape/Texture Server (CSTS) visually searches all storyboards to find images similar to the search image. The search image can be from an existing storyboard or an outside source. A feature vector is created for each storyboard image and maintained in an index. Search images are converted to feature vectors in real time and compared to the index. Emphasis can be placed on color, shape, texture, brightness structure and color structure to direct CSTS results.

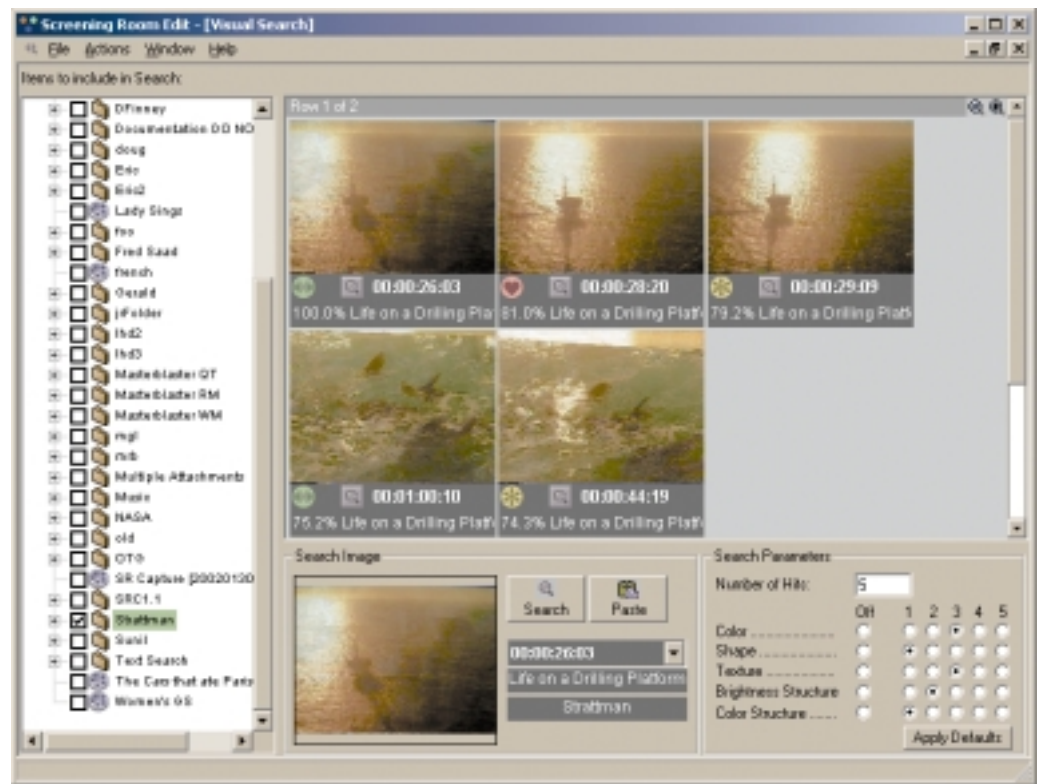


FIGURE 12. SCREENING ROOM IMAGE SEARCH



Convera is a leading provider of mission-critical enterprise search, retrieval and categorization solutions.

Convera's RetrievalWare solutions maximize return on investment in vast stores of unstructured information by providing highly scalable, fast, accurate and secure search across more than 200 forms of text, video, image and audio information, in more than 45 languages. More than 750 customers in over 29 countries rely on Convera's search solutions to power a broad range of mission critical applications including enterprise portals, knowledge management, intelligence gathering, profiling, corporate policy compliance, regulatory compliance, customer service and more.



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