

# Broadcast Quality Video Server: MediaStreamer



By Eddie Ho and Sam Juliano

*The digital video revolution in the broadcast industry has begun, aided and abetted by the recent orders of the FCC. The FCC has further mandated that by the year 2006, all video will be broadcast digitally, with the last of the remaining NTSC analog broadcasts phased out. Broadcasters must begin adapting their infrastructures to accommodate digital video. The MediaStreamer® solutions provide the building blocks to implement this conversion to the digital domain. With its compatibility with current automation and analog delivery systems, MediaStreamer ensures broadcasters a smooth transition to providing television in the twenty-first century.*

In early April 1997, the Federal Communications Commission (FCC) issued a landmark order to the nation's television broadcasters, laying the groundwork for introducing Digital Television (DTV) to the American people. DTV offers consumers the promise of brilliant, high-definition pictures, multiple digital-quality program streams, CD-quality audio programming, and advanced digital services such as data transfer and subscription video.

Under the recent FCC mandate, American broadcasters have been given an aggressive timetable to convert their current

analog-based broadcasting systems to digital. Affiliates of the top four networks (ABC, CBS, NBC, and FOX) in the top 10 markets must be on the air with a digital signal by May 1, 1999. Affiliates in the next 20 largest markets must be on the air by November 1, 1999. By that date, 53% of the television households in America will have the opportunity to receive digital video signals.

Digital video represents a significant advancement in quality and capability over the current analog video system. It will include features such as High-Definition Television (HDTV), video-on-demand, and interactive TV. But what will be a huge benefit for consumers initially will be a huge headache for broadcasters, who have millions of dollars invested in analog broadcast equipment and facilities. Broadcasters will have to convert their existing infrastructure to digital technology with as little impact to their ongoing operations as possible.

Broadcasters have many incentives to convert to digital technology. In addition to the potential of new revenue streams from digital technology, cost justifications include increased productivity, higher reliability, fewer miscues, and lower maintenance. For example, many modern broadcast facilities feature arrays of electromechanical Video Tape Recorders (VTRs) being fed by a "sneakernet" system from a large vault of video tape cartridges. This labor-intensive system can be improved

## Video Life Cycle

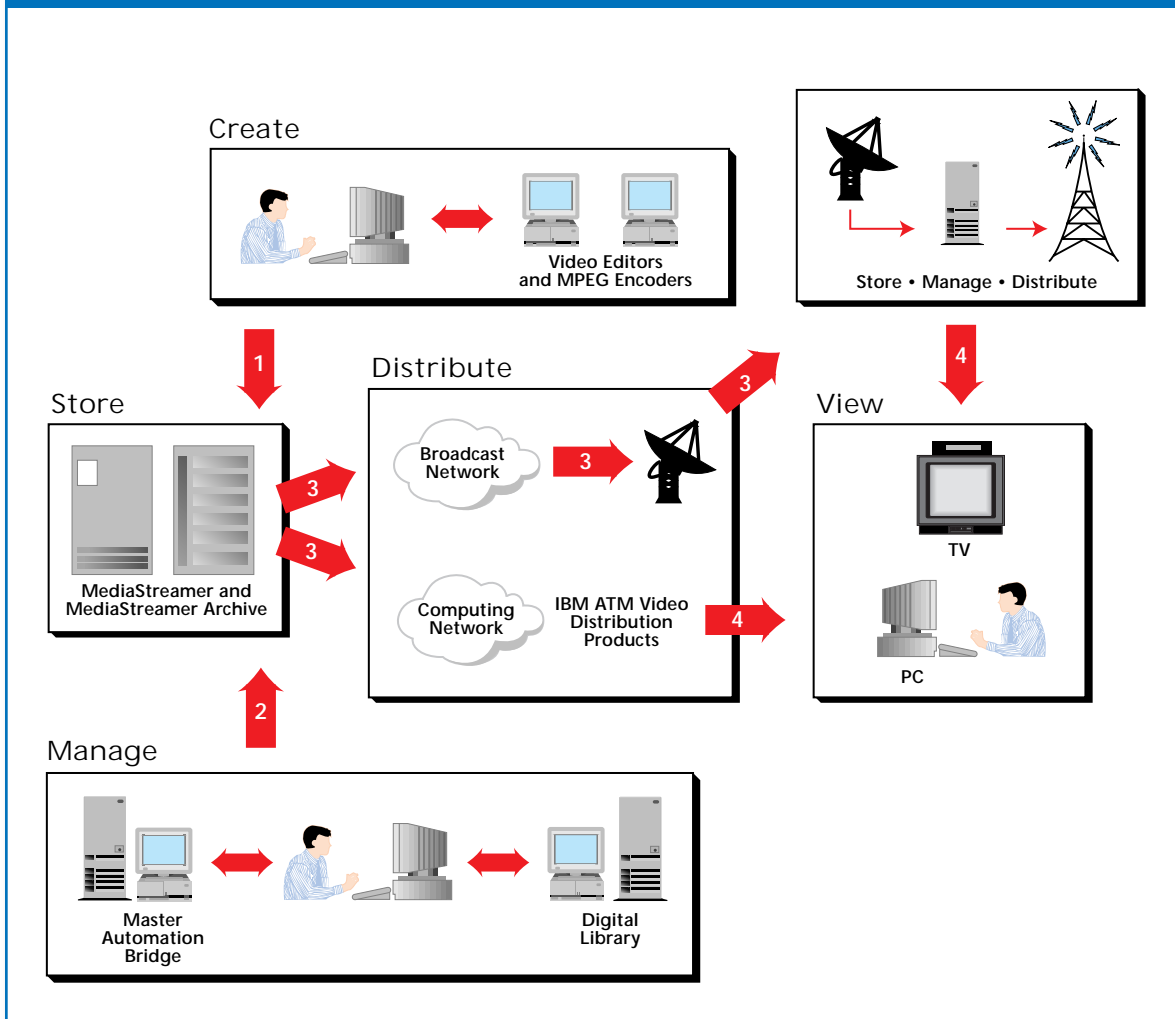


Figure 1. Video life cycle

significantly by the introduction of digital technology, where the VTRs are replaced by a digital video server, and the sneakernet storage and retrieval is replaced by an archive server.

The IBM MediaStreamer solutions are designed to provide broadcasters and other users of broadcast-quality video a system for the efficient storage and distribution of digitally encoded video and audio content. Equally adept at handling both analog and digital outputs, the MediaStreamer can be tailored to meet the needs of traditional broadcast environments while providing the technology for future digital broadcasts. Figure 1 depicts the life cycle of a video product and the MediaStreamer's place in that cycle.

The MediaStreamer solutions are based on IBM RS/6000 workstations enhanced with specialized hardware for video distribution. Expandable, prepackaged systems include two tailored for analog output and two for digital output. In addition, a MediaStreamer Archive solution is available to provide additional storage for facilities requiring larger amounts of data storage.

### Industry Solutions

The MediaStreamer solutions are primary elements for video distribution that can meet the needs of various industries. Figure 2 and the following examples demonstrate the versatility of the MediaStreamer in conjunction with appropriate integration technology.

## Industry Solutions for MediaStreamer

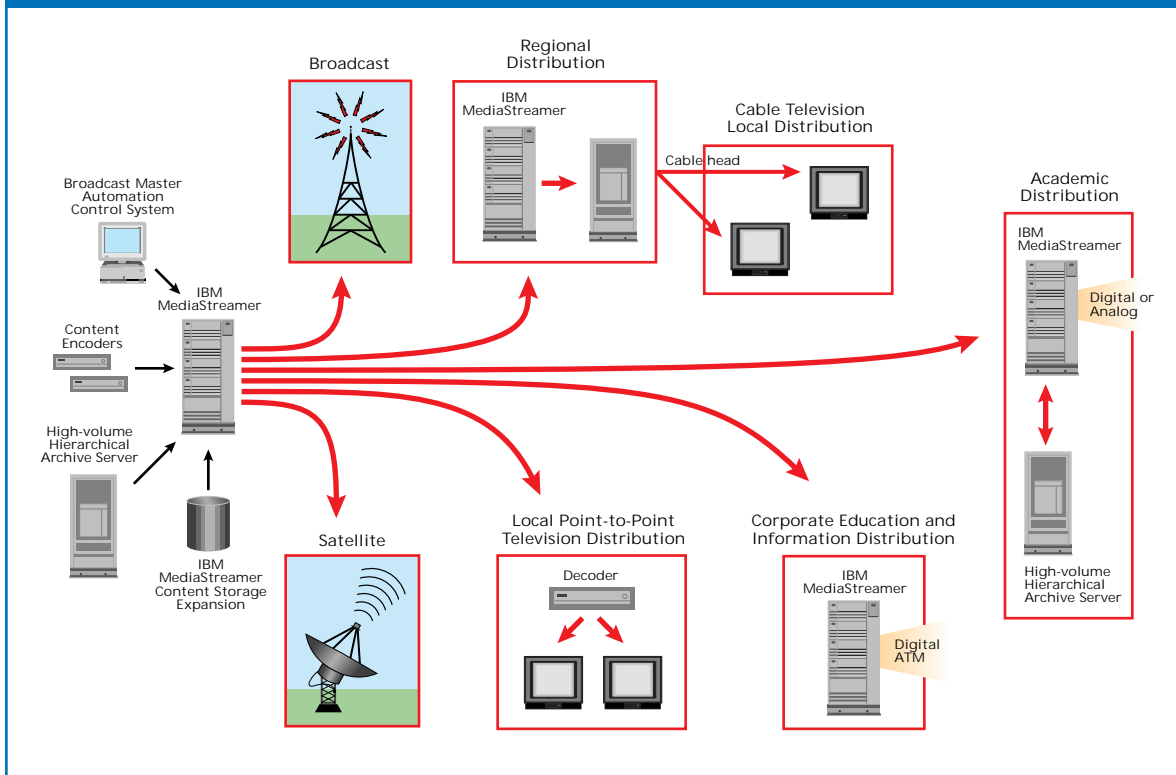


Figure 2. MediaStreamer solutions

**High Availability Analog Broadcast.** Multiple synchronized MediaStreamers provide a tape machine replacement featuring high availability. Automation bridges attached to the MediaStreamers can detect a failure of a MediaStreamer and initiate automatic switchover to the functional unit. After repair of the failed unit, the bridge initiates resynchronization and updates the contents of the repaired system to match the functional unit. Output from the systems is never impacted.

**Distance Learning.** A MediaStreamer and MediaStreamer Archive help provide corporate or institutional video data services, such as news on demand and education or training. Video content is created and encoded externally, then recorded on the MediaStreamer. The video data can be saved on the MediaStreamer Archive until needed. A remote client, such as a Video Distribution Module (VDM) attached to the ATM network, can initiate playback of the

video data and also view the video data when desired.

**Spot Insertion.** A MediaStreamer provides cable systems and network station affiliates with the capability to insert video segments into a video feed at specific times. Both short (for example, 10–40 seconds) and long (for example, 2 hours) video files can be handled equally well. Features of the MediaStreamer, such as the genlock output synchronization, ensure that the insertion process is smooth and unremarkable.

**Time Zone Delay.** The MediaStreamer architecture permits multiple access to a video data file. With this capability, the MediaStreamer provides a broadcaster the ability to schedule separate feeds of the video data at specific times. Even video data that is not completely loaded can be played with the MediaStreamer's "play through" architecture, permitting seven-second censorship delays to be inserted into real-time encoded video feeds.

Scalable Network Operations Center. Network broadcasters can use multiple MediaStreamers and MediaStreamer Archives to distribute different programming to local affiliates. Encoded video data is saved directly to the MediaStreamer Archives as it is prepared. It is then “staged” or moved to the MediaStreamers for playout as needed. Spare MediaStreamers are used for redundancy, and can be hot swapped automatically in case a primary MediaStreamer fails.

### MediaStreamer Architecture

The MediaStreamer is designed to stream MPEG-compressed video over ATM OC-3 fiber-optic interfaces and to stream MPEG decompressed video over NTSC and PAL interfaces. Both MPEG-1 and MPEG-2 (see Figure 3) are supported, but ATM output is not limited to MPEG data. Other types of digital data, such as digitized audio or stock prices, can be stored and streamed as well.

Video data files can be loaded in or staged out of a MediaStreamer without disrupting active streams. Both stream and file access are supported. MediaStreamer record and play commands control stream access, whereas read and write commands control file access. Simultaneous stream and file accesses are allowed, even to the same video

file. Simultaneous writing and reading is also allowed, providing contentionless playback to multiple outputs while the video data file is being created.

These features result from the application of IBM leading-edge computer technologies to the MediaStreamer architecture. Figure 4 depicts the MediaStreamer and its functional components.

**File Storage Manager.** This component is responsible for distributing data throughout the disk storage system in such a way to ensure continuous stream operation. Based on the custom Multimedia File System, it is optimized for storage, management, and distribution of large digital video files, and provides guaranteed bandwidth for data delivery. The File/Storage manager responds to asset management commands issued by the Control Server, and coordinates data transfers with the Data Exporter. The File/Storage manager distributes data across disks to optimize bandwidth of the file system. It is responsible for redistributing file system data when disks are added or removed from the MediaStreamer.

**Control Server.** This component provides the external interface to the MediaStreamer through an Application Programming Interface (API) to clients and

Motion Picture Expert Group (MPEG) Compression Comparison	
Compression Scheme	Typical Characteristics
MPEG-1	<ul style="list-style-type: none"> <li>◆ 352 x 240 resolution</li> <li>◆ 30 frames per second</li> <li>◆ 1.5 Mbps data rate</li> <li>◆ Good quality video with some artifacts during fast-moving sequences</li> </ul>
MPEG-2	<ul style="list-style-type: none"> <li>◆ 704 x 480 resolution</li> <li>◆ 30 frames per second</li> <li>◆ 6.0 Mbps data rate</li> <li>◆ Broadcast quality video, particularly at high data rates</li> </ul>

Figure 3. Motion Picture Expert Group (MPEG) compression comparison

application programs. The Control Server is responsible for the following:

- ◆ Session management: Establishing and closing communications with the MediaStreamer
- ◆ Connection management: Determining the status and availability of streaming ports
- ◆ Stream operations: Associating ports with video files and controlling streaming, interpreting commands such as start, stop, or pause.
- ◆ Asset Management: Managing data files in the MediaStreamer, interpreting commands such as add, delete, or query.

The control server manages the available bandwidth on the MediaStreamer and regulates operations to ensure sufficient resources for all active streams. The control server interprets commands received from

the API and directs the File/Storage Manager and the Data Exporter appropriately.

**Data Exporter.** This component isolates and manages streaming and associated ports. It prepares and provides data to the analog and digital ports. In conjunction with the File/Storage Manager, it supports play and record streams, where data is written to or read from a port. By itself, it supports “pipe streams,” where incoming data on a input port is delivered directly to an output port. Using pipe streams, MediaStreamer can convert an inbound ATM stream into an outbound analog format.

### MediaStreamer Scalability

The MediaStreamer is designed for scalability: all components of the server can be integrated in a single system for small environments, or can be scaled up using multiple systems with distributed components for a very large environment. Users can grow their configuration by adding more data exporter systems to achieve a higher level of performance with a larger number of data streams. Online disk storage can be

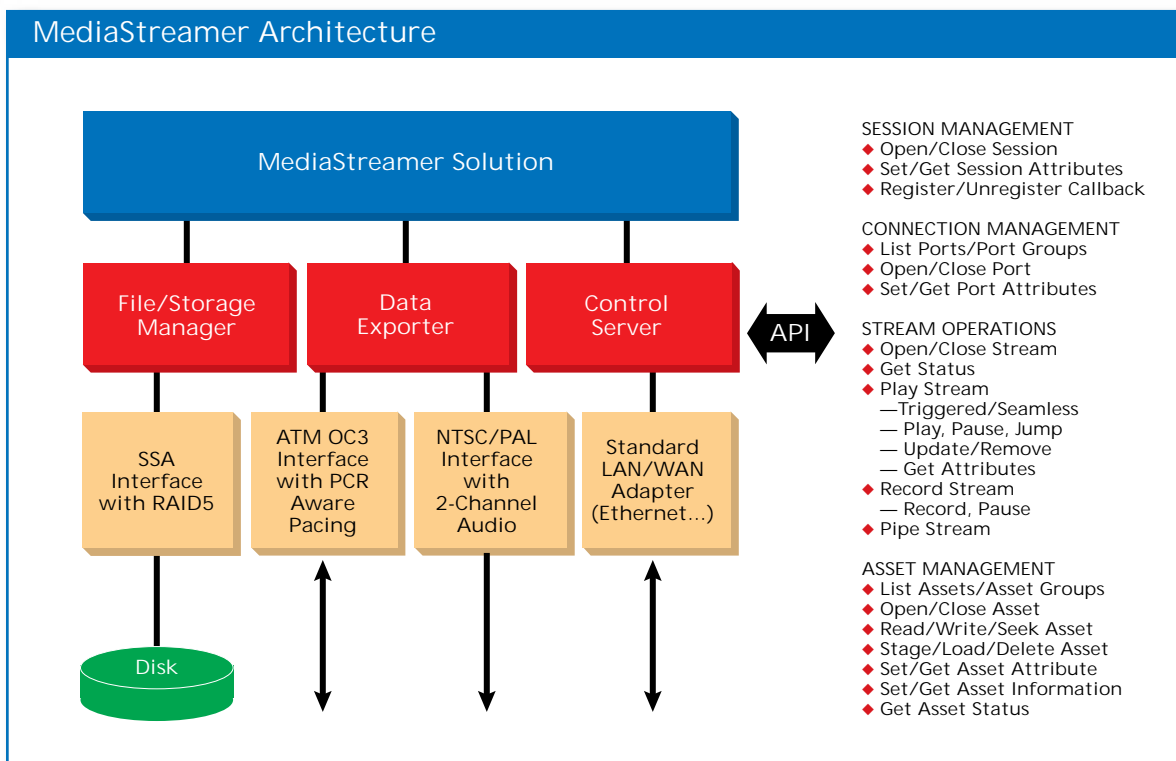


Figure 4. MediaStreamer architecture

## MediaStreamer Functional Specifications

All IBM MediaStreamer solutions meet the following functional specifications.

Maximum number of video streams

- ◆ 42 separate analog play streams
- ◆ 75 separate digital ATM AAL-5 play streams
- ◆ 5 separate digital ATM AAL-5 record streams
- ◆ 10 separate digital ATM AAL-5 input streams passed through to analog output streams

Maximum video system throughput (Any IBM MediaStreamer can be configured to permit a mix of analog and digital output.)

- ◆ Analog play: 100 Mbps
- ◆ Digital play: 120 Mbps ATM AAL-5
- ◆ Digital record: 30 Mbps ATM AAL-5
- ◆ Analog and digital mixed: 100-120 Mbps (mix dependent)

Video stream rates

- ◆ 1.5 to 6 Mbps MPEG-2 transport for analog
- ◆ 1.5 to 15 Mbps MPEG-2 AAL-5 for digital

Maximum content loading capacity (Concurrent video content loading is supported. The throughput must be counted in total system bandwidth.)

- ◆ ATM TCP/IP: 120 Mbps
- ◆ Ethernet TCP/IP: 8 Mbps

Video control

- ◆ Deterministic video control command response
- ◆ Initial title pre-roll (cue) delay less than 3 seconds
- ◆ External trigger option available for frame-accurate starts of analog streams
- ◆ Minimum video clip length: 20 second streams for back-to-back unique titles

Figure 5. IBM MediaStreamer

increased to a maximum of 1.242 terabytes with the addition of multiple RAID disk subsystems. Figure 5 shows the functional specifications of a MediaStreamer solution.



---

*Eddie Ho, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Ho is a programming consultant in the RS/6000 Executive Briefing Center. He has a BS in Computer Science from the University of Wisconsin and an MS in Computer Science from North Dakota State University.*

*Sam Juliano, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Juliano is a staff programmer in Internet Multimedia Development. He has a BS in Electrical Engineering from the University of Texas in Austin.*