The Fox Movietone News Preservation Project: An Introduction

By Andrew G. Setos

This article introduces a series on the Fox Movietone News Preservation Project. At the time it was decided to search for a practical means of preserving this important collection, no hardware or system existed to accomplish such a job successfully. As a practical matter, this task had not been undertaken, using traditional means, because of the huge cost and size of the project. Over 40 million feet of 35mm film was involved in the American collection alone, and many of the images were supported by a cellulose nitrate base. Deterioration of this part of the collection had already begun when the project was started in 1993. A brief history of the company is given, as well as a discussion of the technologies used in the difficult task of conserving six decades of newsreels.

William Fox, owner of the Fox Film Corp., introduced Fox News in 1919. Each week a silent newsreel was created from the news of the day (Fig. 1). In the late 1920s, Theodore Case developed the first in-camera "sound-on-film" recording technique. When Case sold his patents to Fox, the process became known as "Movietone," and Fox's newsreels began to "talk" (Fig. 2). This variable-density sound-on-film process, in use in various forms until the 1960s, inspired the expanded name "Fox Movietone News" for the company. A Fox Movietone News sound recording truck, circa 1930, is shown in Fig. 3.

At its peak, Fox Movietone employed over 1,000 film crews worldwide (Figs. 4 and 5), sending stories to its New York City headquarters at 10th Ave. and 54th St. Ultimately, audiences in 47 countries would see at least two different newsreels each week (Fig. 6). Even though the Fox Film Corp. merged with Twentieth Century Films in 1935, the name Fox Movietone News remained actively in use until 1963. Among the memorable events exclusively covered by Fox Movietone News were the assassination of the king of Yugoslavia in 1934, the dramatic explosion of the hydrogen-filled zeppelin *Hindenburg* in Lakehurst, N.J., in 1937, and the attack on Pearl Harbor in 1941.

Each newsreel consisted of five to ten stories, sometimes only a day old. The very word "newsreel" derived from the operational limit imposed by the practice of filling one reel, and one reel only, with newsclips (Figs. 7 and 8). The reel size (1000 ft, or slightly over 10 min) was dictated by the burning time of the carbon arc rods used in theatrical projectors of the day. A length of greater than 1000 ft would have required "breaking down" the film into two reels, hence the word newsreel.

The American collection of stories, outtakes, and shorts consists of more than 40 million ft of 35mm film and over 3 million 5 x 7-in. cross-indexed file cards. Owing to the era when the material was photographed, many of the images are supported by a cellulose nitrate base. Not surprisingly, deterioration of this unstable part of the collection had already begun before the project started.

Mission

While Twentieth Century-Fox Film Corp., which owns the material, had always desired to preserve the collection, as a practical matter the task had not been undertaken because of the sheer size and cost of such a project. The standard approach, printing to safety film, would have taken over a decade. This long schedule was estimated based primarily on the shrunken and brittle condition of the film, which would greatly limit printing speed. While this would be the conservative approach, valuable early material would certainly have been lost to deterioration (over the time required to complete printing).

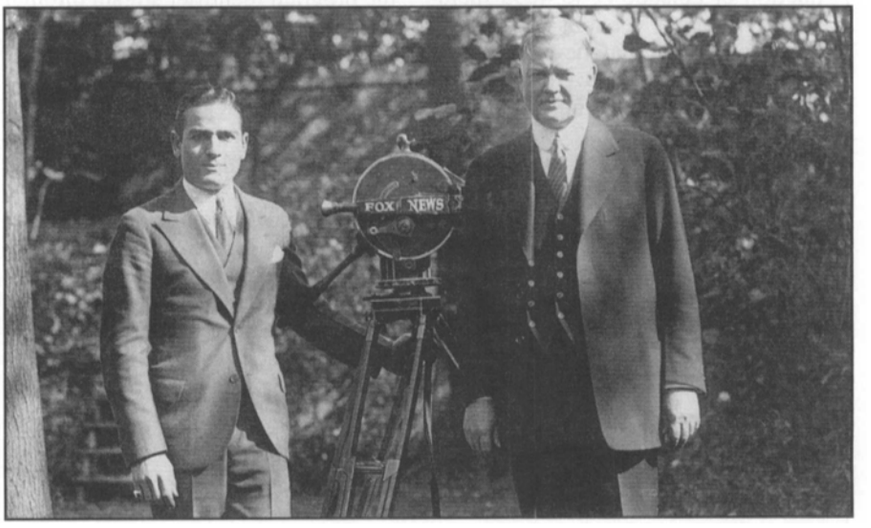

Figure 1. Then Secretary of Commerce Herbert Hoover (R) with unknown person, believed to be the head of Fox News, ca. 1927.

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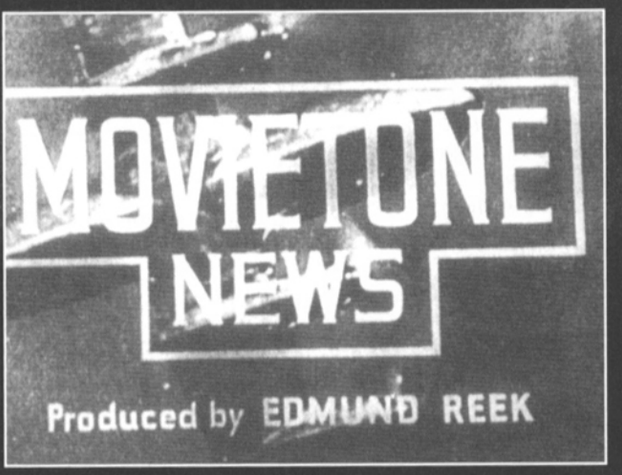

Figure 2. Introduction to early Movietone newsreel.

Figure 3. A Movietone sound recording truck, ca. 1930.

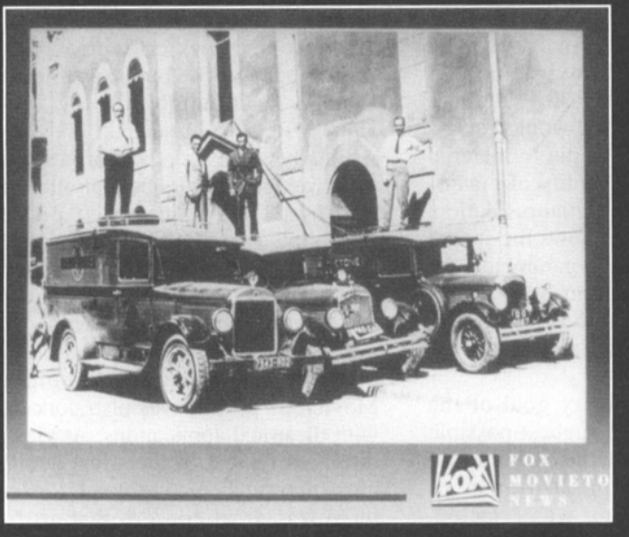

Figure 4. A Movietone crew on location.

Figure 5. General view of cameramen's cars and equipment in Europe, ca. 1938.

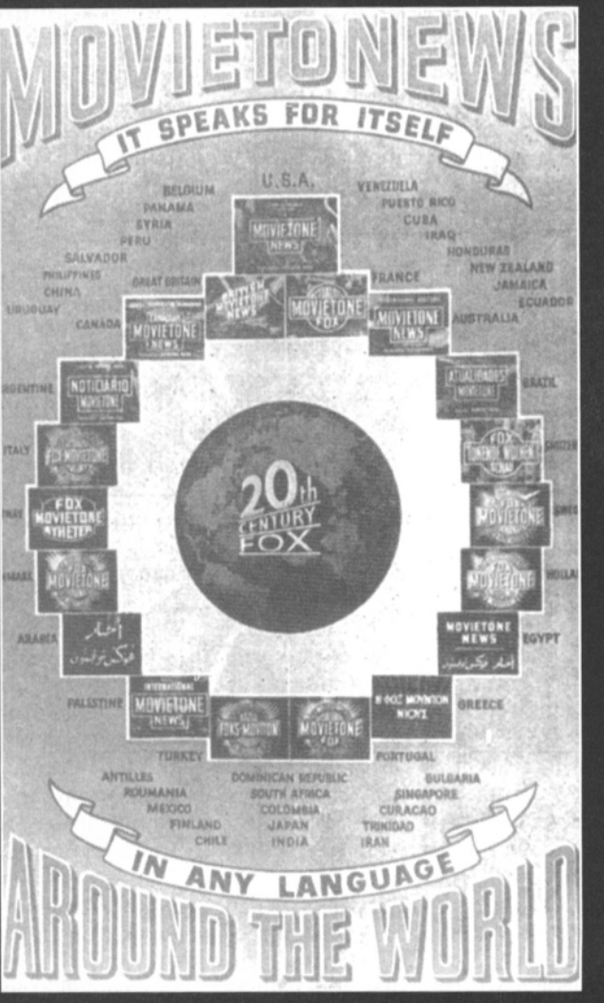

Figure 6. The news was sent around the world in many different languages.

Furthermore, after a photographic preservation there would still not be any video viewing copies, which would have required a telecine project of equal magnitude to the film preservation.

Over the years proposals had been made to transfer the entire library to analog videotape. However, these had been rejected on grounds that the rich visual quality (measured in both tone reproduction and spatial resolution) would be lost forever. The various digital video recording formats using the CCIR 601 standard (484 or 576 interlaced lines x 720 pixels at 8 or 10 bits/pixel) were also deemed inadequate, for the same reason.

Ultimately, we defined "preservation" as capture quality that would, in turn, record photographic film whose image would appear equal to the original in a theatrical viewing environment. In summary, our challenge was to capture as much information as the film held in a reasonable time.

In 1993, it was decided to search in earnest for a practical yet faithful means to preserve the Fox Movietone News collection. At that time no hardware or system existed to accomplish such a task successfully.

Technology

While several technologies were needed in the preservation effort, intuitively the most difficult hurdles involved the image sensor and digital recorder. Given the shrunken and warped film sure to be encountered, a strategy of area exposure was selected. This dictated the use of charge-coupled device (CCD) arrays. While arbitrarily high spatial resolution CCDs were available on the market, the requirement for a timely completion demanded 24 frame/sec operation. "Sound speed" added the benefit of allowing real-time evaluation of sound pickup during scanning. An Eastman Kodak CCD was selected. The active area provides an array of 1018 x 1008 pixels.

The recorder requirements included our desire to capture 10 bits/pixel of tone reproduction. While 8 bits is standard for most television applications and computer-generated graphics for motion picture work, 10 bits is more realistic for continuous-tone images of vintage newsreel material. At the time the fastest available data recorders conformed to the ANSI ID-1 standard and operated at a maximum of 35 Mbytes/sec. There was a faster recorder, but it had operational handicaps and the media was an order of magnitude more costly. The ID-1 format was chosen (Fig. 9).

As a check on the chosen sampling values, a few frames from each of the six decades of Movietone's operation were scanned at very high resolutions (3000 x 3000 pixels) and pixel depths (14-bit linear). These images were compared to those from the 1018 x 1008 10-bit sampling. The information content of the film was found to be a good match to the selected sensor and recorder.

Image Capture

One of the cornerstone parameters identified for the overall project was a single digital frame record for each film frame. Mainstream film rates are either 16 frames/sec, used during the silent era, or 24 frames/sec, which was standardized when sound was introduced in the late 1920s (Fig. 10). However, North America selected 30 frames/sec for broadcast television.

In the pre-solid-state era it was impractical to decouple the source frame rate from the display frame rate. Historically, therefore, (in System-M countries) film scanning devices have always expanded the information rate of film by repeating fields.

From a purely economic viewpoint in a bit rate limited environment, a data recorder recording 30 frames/sec instead of 24 frames/sec would carry a 25% cost penalty in media (a material premium given the quantity of material) and a sacrifice in spatial resolution. For instance, Table 1 shows the spatial and temporal resolution parameters for the ID-1 format recorder at its maximum recording rate of 35 Mbytes/sec. Notice the severe data rate penalty for frame replication.

As it was the primary goal of the project to achieve the highest possible capture quality within the constraint of "real time" operation, 30 frame/sec "expanded" recording was rejected. The function of display "formatting" was therefore transferred from the scanner to the playback electronics.

Compression

Any data storage project planning to record over 1000 Tbytes would be well served to consider compression of some sort. Many strategies were considered.

Interlace, developed in the late 1930s to allow for more practical video circuits, reduces analog bandwidth requirements by a factor of two. However, as television cameras, conventional film scanners (telecines), computer graphics equipment, and television receivers begin to equal the theoretical performance of any arbitrary interlaced scanning system, the compression artifacts of interlace become all too apparent (line twitter, intraframe breakup of vertical edges, and, most of all, a 35 to 40% reduction in perceived vertical resolution with respect to progressive scanning.)

To be sure, interlace is today used worldwide in most broadcast television applications. This is not surprising, given that they were all developed in the late 1930s. However, the almost universal acceptance of standard scanning (otherwise called progressive) in computer-generated graphics and imaging for motion picture applications is a testament to the obsolescence of interlace.

MPEG techniques all rely on motion redundancy to achieve significant reductions in data rates, upwards of 100 to 1. However, the ability to edit MPEG-compressed material is severely limited. The bulk of Fox Movietone News collection is not "finished" work, but raw unedited footage. Accordingly, for this reason alone MPEG was rejected.

Finally, there are a host of intraframe compression techniques that allow full editing. Today, the most popular approach is embodied in the JPEG standard based on discrete cosine transform (DCT). Others include wavelets and vector quantization. While some intraframe coding is being successfully used in broadcast television, the Movietone project was also concerned with theatrical applications. At viewing distances typical of theatrical auditoriums (two times picture height or less), there was great concern that artifacts would be visible. It was finally decided to discard consideration of any compression approach.

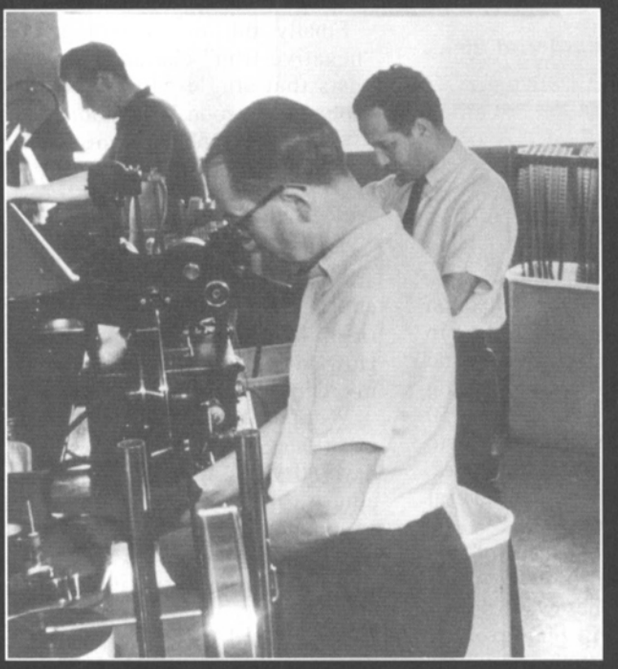

Figure 7. View in the cutting room showing three cutters putting the newsreel together (European Movietone), ca. 1938.

Figure 8. Second view of the cutting room, ca. 1938.

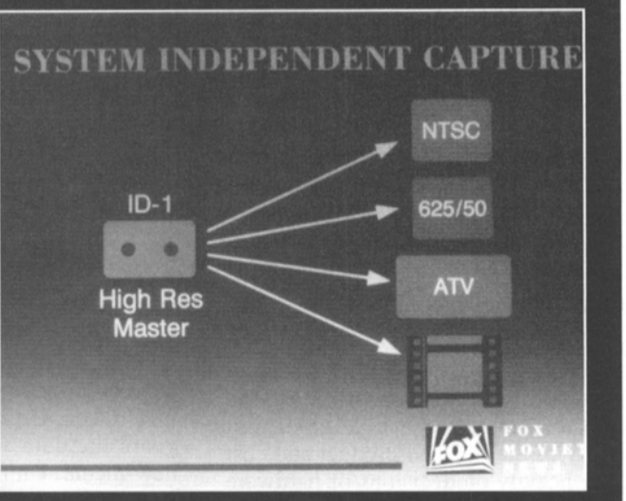

Figure 9. System independent capture using the ID-1 tapes as masters.

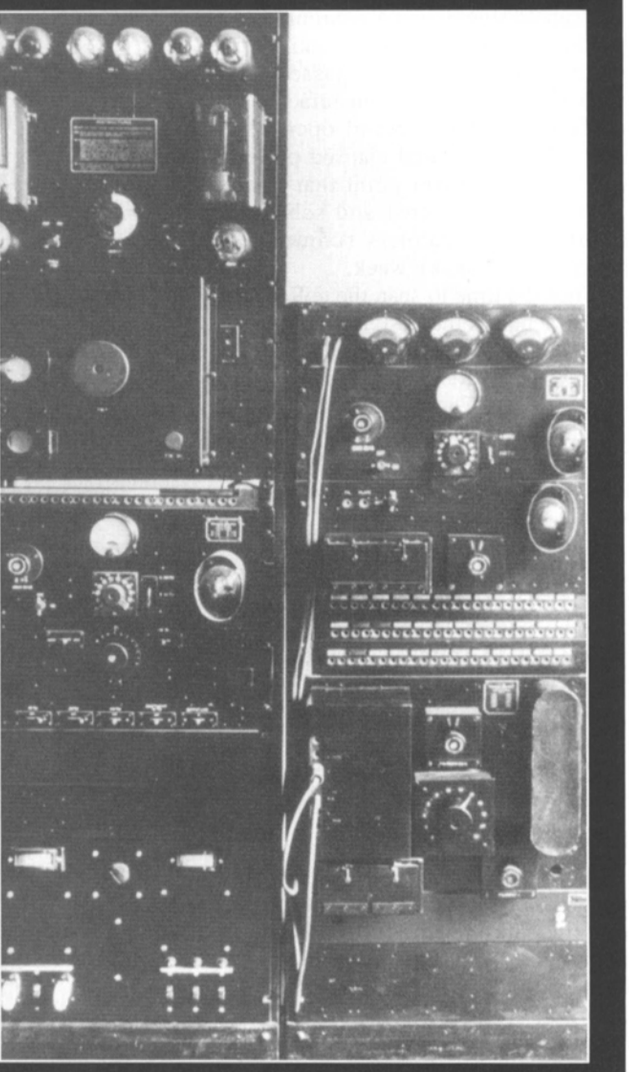

Figure 10. Main sound amplifiers used in France ca. 1938.

Table 1 — Spatial and Temporal Parameters for ID-1 Recorder at 35 Mbytes/sec

Frames/sec	Mbytes/frame
16	2.19
24	1.46
30	1.17

Operations

A project of this size is not just a study in technology, but of industrial process. Not only was time of the essence, as already mentioned, but utility of the finished product and cost bore heavily on decisions of hardware and human factors.

To illustrate the challenge, if the entire collection were spliced together and run at sound speed continuously, the film would not run out until after more than one year had passed. An evaluation was made of manufacturing multiple scanners, cost of operation, and overall estimated elapsed project time. The crossover point that minimized both total cost and schedule involved two scanners running 24 hours a day, 5 days a week.

Since the time to scan the collection was so lengthy, the design of the scanners included recorders of various types so that all materials would be made at once. These included two ID-1s, one NTSC Betacam SP, and three NTSC S-VHS recordings. This was another benefit of scanning at sound speed.

Silent film was also scanned at sound speed, but only ID-1 recordings were made. At a later time System-M recordings were derived from the ID-1 playing at 15 frames/sec and frame repeated to 30 frames/sec.

The vast number of labels required and the complex machine controls were all automated under computer control.

Results and Observations

At this time the scanning of over 40 million ft of 35mm film has been completed. That includes all footage remaining in the collection. Each of the 3 million 5 x 7-in. file cards had its information entered into the beginnings of what will be a CD-ROM database and search engine. That task was scheduled for completion in the summer of 1996. While the collection has now been preserved forever in numeric form, careful monitoring and storage of the magnetic media is being undertaken. Ultimately, after 25 to 50 years the data will be transferred to new media. Unlike analog techniques, this process can be repeated several times without data loss.

Beyond the overall success of this preservation effort, promising technologies and techniques were developed that we hope will play exciting roles in the motion picture and television industries. Fox has already put in place other 24 frame/sec video systems for use in film-based capture and release. Given the appeal of single inventory video recordings for international use and the acceptability of 24 frame/sec capture, we can only see the use of this technique proliferating.

Motion picture sound tracks made before 1950 were produced only in optical photographic form. The laser-based sound head developed for the project will play heavily in future sound-track preservation.

Finally, full tone recording, akin to "negative film" characteristics, suggests that single-camera electronic capture may soon be a viable alternative to photographic capture for television applications.

Acknowledgments

This issue of the *Journal* includes articles by many of the engineers, scientists, and companies that took part in making this project a success. However, a few special mentions are in order.

Without the standards-setting legacy of our Society, dating from its first days 80 years ago, the project would almost certainly have been too costly or impractical. The decision and ultimate funding to proceed with this new and radical preservation approach came directly from Rupert Murdoch, chairman and CEO of Fox's parent, the News Corporation Ltd. The dedication, knowledge, and skill of Pamela Kersey, director of post-production operations, and Roger Bell, executive director of library services, both of Fox, were essential to the full success of the effort. William Peck and Ron Uhlig were instrumental in engaging the full depth of Eastman Kodak resources to aid the project. Irwin Young of Du Art Film Laboratory gave the project much-needed early moral support. And finally, thanks to Evans Wetmore for being the best collaborator any engineer could hope for.

THE AUTHOR

Andrew G. Setos is executive vice-president of the News Technology Group, whose role is the strategic assessment and deployment of technology to enable and enhance the businesses of the News Corp. Ltd. He also holds the position of senior vice-president, broadcast operations and engineering, Fox Television, which includes Fox Broadcasting Co., Fox News, Fox Sportsnet, and Fox TV stations. Prior to coming to Fox and News Corp., Setos held senior engineering and operations positions at Viacom, Warner Amex, and WNET. He was involved in the launching of MTV, "The MacNeil/Lehrer Report," and "Live from Lincoln Center."

Setos is a Fellow of the SMPTE. He has a B.S.E.E. from Columbia University School of Engineering and Applied Science.