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100 Years of SMPTE Standards

While SMPTE is based on three pillars of activity, namely, Membership, Education, and Standards, creating industry standards has been a core activity since 1916 when the Society of Motion Picture Engineers (SMPE) was formed for that very purpose. Obviously, many things have changed during these 100 years—particularly the technologies we standardize and the technologies we use to create and publish standards—but the fundamentals of standards creation, as well as the essential role of standards in the industry, remain largely unchanged.

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Film

In 1916, SMPE was asked to bring order to a world where the many variants of film cameras created films that could be projected only on the corresponding projector from the same designer or manufacturer. The most common format, that is, the 35 mm film, already existed when SMPE was formed, but the publication of a full set of standards was a key factor in this format becoming the foundation of the movie industry, as well as its survival to this day. With the advent of "talkies," a frame rate of 24 frames/sec was established, and this, too, survives today—even being adopted by many television productions.

Film technology and applications advanced in many areas: sound, color, widescreen, and several generations of 3D. The quality of the film itself, as well as of the associated equipment, including cameras and projectors, increased dramatically, and the 35 mm image, still beloved by many cinematographers, became the standard against which all competing technologies were judged. Throughout this time, the standards applicable to all aspects of film and related technologies were updated and refined to maximize the benefits to the industry. Even apparently mundane details contributed to the success of the industry; for example, the exact shape, size, and positional tolerances of sprocket holes were refined well into the 20th century, resulting in improved image stability and enhanced longevity of release prints. The 35 mm format was ubiquitous, and prior to the recent emergence of digital cinema, a 35 mm film could be displayed reliably on well over 150,000 screens in all countries around the world.

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Television

In 1950, the role of the Society was officially expanded to include television, and we became SMPTE. Transmission standards for monochrome television in the U.S. had been developed by the National Television Standards Committee (NTSC), and the second iteration of this committee developed the well-known NTSC color television standard in 1952. SMPTE's role was to develop the standards necessary to generate pictures and sound for transmission, as well as to facilitate interoperability of television equipment from different manufacturers.

Interoperability changed the face of the industry. In the early days of television, a station would generally be constrained to buy everything, from camera to transmitter, from a single manufacturer. Equipment from a different manufacturer could not normally be used in the system. The evolution of a comprehensive set of standards changed this; users could "mix and match" and pick the most suitable or cost-effective item of equipment for each requirement—resulting in greater competition, more versatile equipment, and lowered costs for users. Standards also are key to new companies entering the field. With a standardized infrastructure, small companies can enter the market with "niche" products; they do not have to provide the complete chain in order to become a player in the market.

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Color came to television in the 1950s, and it rose to prominence in the 1960s, but the biggest change to television as an industry was probably the introduction of the videotape recorder (VTR) in the 1960s. Originally conceived as a mechanism for program delay across the various time zones of the U.S., the VTR quickly changed the industry from mostly live programming to preproduction (and, with the advent of editing systems, post-production) of the majority of programs outside of live news and sports.

This era was also very significant in the world of SMPTE standards. VTRs, as well as the tape they used, came from various manufacturers, and standards were absolutely essential to successful recordings and reliable interchange. In this era, engineers from the user community were very active in standards development, and the combined voice of many users was sufficient to coerce manufacturers into agreeing on a common standard for a new class of VTRs—one that dominated the marketplace for many years.

Initially, SMPTE television standards were focused on countries that adopted the NTSC transmission system, and the majority of standards participants were from the U.S. and Canada. The European Broadcasting Union (EBU) published many of the standards for use in the 50 Hz countries using the phase-alternation line and sequential color and memory systems. SMPTE and EBU cooperated in many areas, the most significant being a Joint Task Force in 1981 that established the basic parameters for digital television (CCIR 601/BT.601) and the SMPTE/EBU Task Force on the Exchange of Program Material as Bitstreams that established the basic concepts that led to standards for the handling of video and audio essence, as well as associated metadata. The dialog with EBU led to further cooperation and EBU's decision to entrust SMPTE with the development of standards for European television systems, in addition to those for North American systems. In effect, SMPTE became the source of studio standards for the television world.

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Digital Cinema

Large screen projection of electronic moving images had been a goal since the introduction of television. Eidophor systems produced color images for venues in the 1960s and very large, high-quality images by the 1990s, but the systems were large and expensive and never threatened

the economics of movie distribution by 35 mm release prints.

Texas Instrument's demonstration of the DLP® (Digital Light Processing) projector in 1998 was probably the most significant event leading to serious consideration of electronic distribution and projection of mainstream cinematographic material. If a suitable system could be devised, the economics were compelling. Release prints are expensive to make, heavy and expensive to ship, last only a few weeks, and have to be returned and destroyed to avoid rampant piracy. Hollywood was spending well in excess of $1 billion/year on release prints.

At this time, high-definition television (HDTV) was well established, and some believed that HTDV was a plug-in solution for digital cinema. The movie industry disagreed. It considered that the quality of image represented by 35 mm film could not be approached by HDTV and that an entirely new system was required. This was the view adopted by SMPTE, and D-Cinema (as it became officially known) was developed in a separate Technology Committee. There were many contributions to D-Cinema technology from the television world—most significantly, perhaps, the Material eXchange Format (MXF) file format for distribution—but all aspects of image quality and coding were developed specifically for D-Cinema, with the critically important contribution of the cinematographers. A major event in 2004 was the first large-scale demonstration for D-Cinema of the 2K DLP® projector when many realized that the system could provide images comparable with the best release prints.

However, the greatest complexities of D-Cinema were business related rather than technological. Studios, distributors, and theaters all needed a system that was financially viable, not just a good technology. These discussions are not appropriate for SMPTE committees, and it is not likely that acceptable solutions could have been devised in a public forum. Digital Cinema Initiatives was formed by the studios and created a specification based on the concepts developed within SMPTE, as well as incorporating the security systems essential to a viable movie business. Other parties created financial systems that could support the transition for theaters, and D-Cinema was born.

The success of D-Cinema has been phenomenal. Significant deployment began in 2006, and by the end of 2015, there were over 140,000 D-Cinema screens worldwide, well over 90% penetration. D-Cinema also provided another opportunity for stereoscopic 3D movies, with higher quality and fewer artifacts than any film-based system. Over half of the D-Cinema screens are 3D capable.

The Internet and IT Systems

The original film pull-down device was adapted from a sewing machine mechanism, but most of the development of film equipment has occurred within the industry. Until recently, most television systems have been based on proprietary hardware and/or software systems. As in many industries, that has all changed. Most television functions and many of the elements of the digital cinema chain can be implemented on hardware and software platforms provided by the IT industry, or built using components from this industry. Post-production is already almost entirely based on networks and IT products; new distribution systems rely on the internet; only live production and linear program streams still use many of the traditional approaches—and even these depend more and more on IT technology.

It is inevitable that progress in the IT industry will lead to this technology being the only economically viable approach. This leads to some tensions today. There are those who see this inevitability as a reason to abandon work on all non-IT solutions. Others, although they recognize that IT will be pervasive, believe that traditional pragmatic solutions are a good choice for today, deferring a move to total network connectivity until solutions are tried and tested and, potentially, more affordable.

SMPTE embraces all of these viewpoints. Work continues on high-speed versions of conventional interfaces, and work is under way to standardize network transport of video and audio. However, even the latter can be viewed only as interim solutions; SMPTE is working with other industry groups to visualize the architectures of the future where networked services may not require serial interchange of conventional rasterized video.

Much of the work important to the networked world is not directly related to network hardware or protocols. File formats such as MXF (Material eXchange Format), packaging systems like IMF (Interoperable Master Format), and object storage for archiving by AXF (Archive eXchange Format), service discovery, registration, and device control over IP; all are important elements to allow creative and efficient use by our industry of the tools brought to us by the IT industry.

The need for versatile metadata systems in our industry was identified by the SMPTE/EBU Task Force on the Exchange of Program Material as Bitstreams. SMPTE was a pioneer in metadata standards, but that presents its own problems. The tools used initially are outdated and cumbersome to use, and volunteers and staff are engaged in a complete overhaul to provide better tools, improved access, and timely response to the needs of those working in the field. Phase two of AXF is focusing on the collection and structuring of metadata during production, so that the eventual archive will include all the metadata necessary to make the archive truly useful. This work provides an approach to what has been the most intractable of problems—a simple and practical way to bind metadata to the appropriate essence.

Organization, Participation, Process, and the Future

SMPTE standards are created by a partnership—SMPTE staff provides the infrastructure, publishing services, and general support; volunteers provide the expertise and most of the authoring work. It is important to note the critical roles played by a few select volunteers. The Standards Vice President, the Standards Directors, and the Technology Committee Chairs all play substantial and vital roles in the process. Each of these roles requires experience and expertise, as well as a great deal of personal time. We sincerely thank all of these individuals and, where applicable, the employers who support them in their SMPTE activities.

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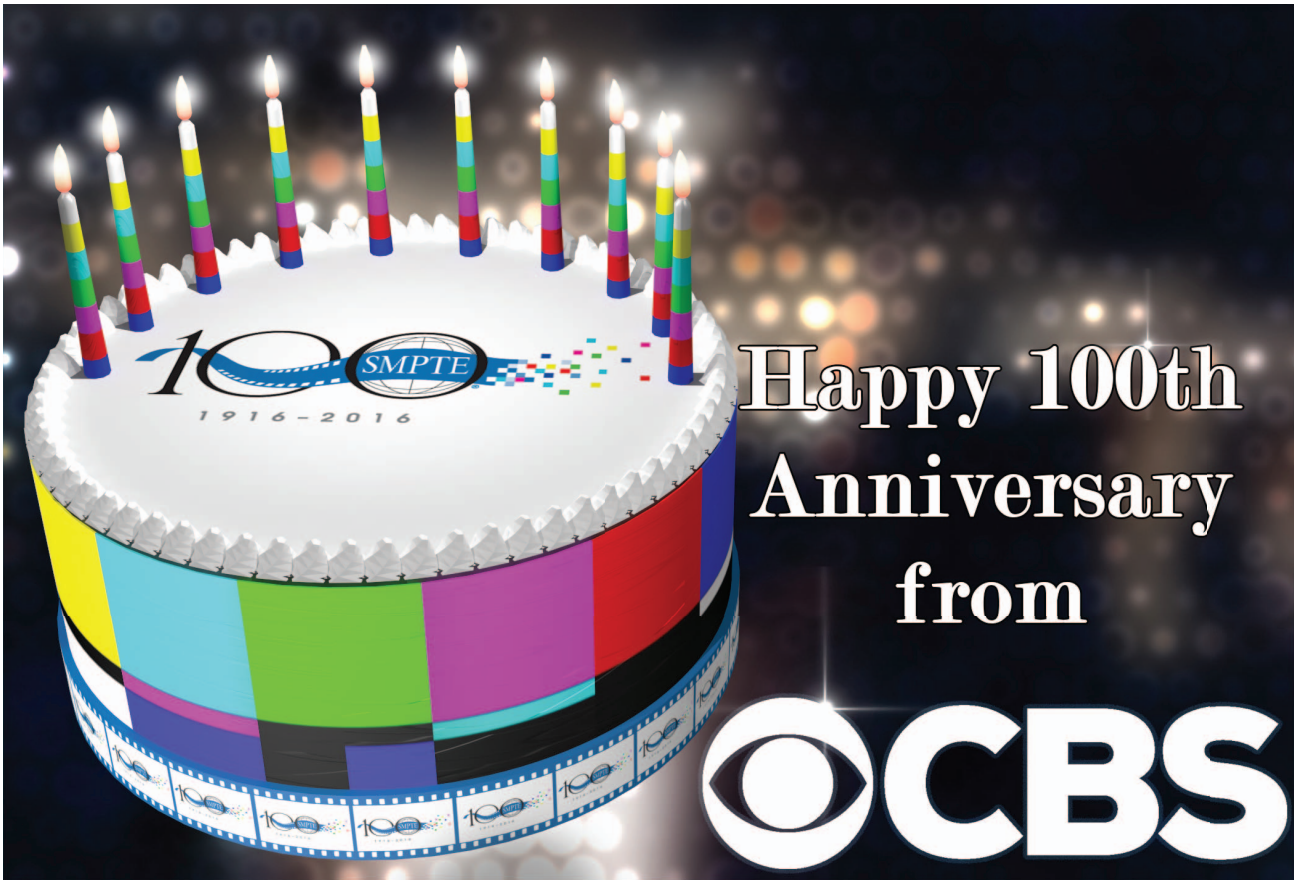
It is important to mention the support provided by organizations who host face-to-face SMPTE standards meetings. Although most of the standard development work is conducted through online meetings, these quarterly in-person meetings are an important part of the process and provide a venue for targeted discussions and resolution of differences, as well as superb networking opportunities. Many companies provide facilities for these meetings, at little or no cost to SMPTE. Some host a single meeting block; others are regulars. All report that hosting is a positive experience for the company and its staff. This support is a very important factor in keeping the cost of participation in SMPTE standards low, and we are always grateful to our hosts.

All the volunteers are important, as is the support of their employers. In any Standards Development Organization (SDO), quality work requires broad participation from every industry sector. In this age of continually challenged headcounts, many organizations, particularly smaller companies, find it difficult to provide experts with the time for standards participation. However, the benefits can be enormous, and few would wish that the standards that will define the future of their industry be left to others.

SMPTE makes participation as easy as possible. All meetings, including the face-to-face meetings, are accessible remotely from anywhere in the world.



The need for efficiency in standards development and the increased interdependency of all functions in a networked world have emphasized the need for inter-SDO cooperation. Today, SMPTE works with a very large number of national and international SDOs, as well as with many trade groups. The Society's contributions are recognized by the accreditations of the American National Standards Institute (ANSI) and by international organizations such as the International Telecommunication Union and the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC).

Finally, after 100 years of standards development, the tools have changed. Early standards relied on documents first handwritten, then typed then typeset for publication—after a draftsman had prepared the precision drawings needed. Word processors helped in document preparation, but for many, many years, the development process was paper intensive. A group of standards meetings was characterized by arriving with one suitcase full of paper and leaving with two. The process has evolved through local networks and servers, to web services and online collaboration, providing the necessary information to all participants, no matter where located. Now, since most SMPTE standards are software related, or include code, schemas, test vectors, etc. the tools available to developers include issue tracking software, repositories, and online databases.

However, there is a need for education. In today's world of fast-moving technology, many young people see standards as archaic and constraining. This is a strange perception in the era of network and internet technology, where incredibly rapid evolution has been made possible by the existence of a comprehensive set of well-written standards from organizations such as the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF). Perhaps the point here is that good standards provide an environment or infrastructure that just appears to be the "natural order of things," and the users who build on them can remain largely unaware of this foundation. We need to show, and persuade academia to teach, that standards exist, not to constrain, but to provide a platform that allows developers to exercise their creativity.

Thus, many things have changed since 1916, but the essentials of the work remain. In 2016, we still gather experts from all parts of the industry to develop standards that will benefit the industry as a whole by providing interoperability, economies of scale, and platforms that are the basis for innovation. The next hundred years will bring technologies we cannot imagine today, but it is likely that a cooperative standards process will be an important element in making the best use of those technologies. SMPTE