

Executive Summary

The expected convergence of television, computers, and communications is occurring. It is impacting television production, post production, and distribution through the appearance in television systems of video and audio compression methods, server technology, and digital networking. These technological changes offer the potential of huge benefits in reduced cost, improved operating efficiencies and creativity, and increased marketability of material. They also pose the threats of confusion, complexity, reduced technical performance, and increased costs if not properly managed. They clearly will radically change the way in which television is produced in the future.

In this context, the Society of Motion Picture and Television Engineers (SMPTE) and the European Broadcasting Union (EBU), joined by members of the Association of Radio Industries and Businesses of Japan (ARIB), formed the Task Force for Harmonized Standards for the Exchange of Television Program Material as Bit Streams. The Task Force drew the participation of about 80 experts from around the world who, meeting on five occasions in Europe and the United States, produced this report to guide the industry in its decisions regarding specific implementations of the technology. The report is also meant to steer the future development of standards intended to maximize the benefits and minimize the detriments of implementing such systems.

The Task Force was charged with developing a set of user requirements against which proposed solutions can be measured. In the few meetings available to deal with a subject having myriad implications and applications, the Task Force achieved a remarkable level of understanding of the problems to be solved and in setting the future direction in a number of areas that will facilitate the implementation of digital television systems based on bit streams. Although it was not able to resolve all of the issues that came before it, it nonetheless succeeded in providing significant mechanisms for rationalizing the differences likely to occur in practice.

In carrying out its work, the Task Force divided the effort into five fundamental areas of investigation: compression, physical link and transport layers for networks, wrappers and file formats, metadata, and file transfer protocols. Each was assigned to a sub-group that produced a portion of the report. In some cases, the sub-groups found that their areas of responsibility were so linked to one another that they did their work together and produced a unified output. This has implications for the associated technologies and standards that will derive from this work.

The compression technology used for processing video and audio is at the core of the changes that are occurring. It permits the digital transmission of program material through bandwidths that hitherto could not support digital signals. It permits the storage of that material in servers that make access to the material virtually instant and that allow simultaneous use by multiple users. These all have the effect of

improving the efficiency and reducing the cost of producing and post-producing the material. Looked at another way, the compression technology has the effect of dramatically increasing the quality that can be achieved in transmission or storage confined to a particular bandwidth or data space.

The choice of appropriate compression schemes has significant impact on the overall cost / performance balance with-in production, post production, and broadcast operations as it will affect quality, storage / transmission efficiency, latency, editing / switching of the compressed stream as well as error resiliency.

The participants attempted to offer guidance for the long-term integration of compression into program production. The discussions revealed contrasting views between members on how best to achieve this. The issue is moot in a sense because a number of manufacturers have already introduced compression schemes to the market which target specific areas of applications, using different data rates as well as incompatible compression algorithms. The functional interoperability and exchange of video data between equipment employing different and incompatible compression algorithms is therefore currently achieved by transcoding to the high bit rate level defined in ITU-R BT.601.

The participants acknowledged that the rate of development of technology is moving at a fast rate and that, within the wide gamut of individual operational requirements, only a common methodology in handling different compression schemes can lead to the minimization of difficulty when interchanging program material and will retain predictability of the technical quality of the released output product. A number of key user requirements to achieve these goals were identified. A degree of optimism is necessary that these will be implemented. Users and manufacturers were invited to maintain an ongoing dialogue to reconcile conflicting requirements and to achieve harmonization in the area of compression.

The physical link and transport layers provide mechanisms that allow moving compressed video and audio streams and files from one place to another. Wrappers and file formats are used to contain program elements and other data in ways that it can be stored, retrieved, and transmitted as identifiable objects. Metadata ("bits about the bits") is descriptive and supplementary data that can be used either to interpret other data that carries program elements or in conjunction with those program elements. File transfer protocols are methods for transferring program elements and metadata, contained in wrappers and/or files, through physical and link layers by means of specific transport mechanisms to other locations.

With regard to the physical, link, and transport layers, the requirements were identified in terms of a number of quality of service (QoS) classes that were examined in relationship to specific applications. From this study, there is gen-

eral agreement that standards are required to provide means for carrying program material as bit streams over two types of physical interfaces – direct connections between individual equipment units and networks where common interconnections are shared between multiple equipment units. With regard to direct connections, the standard needed is one that permits continued use of the existing serial digital interface (SDI) as currently embodied in international standards. For networks, decisions must be made on a limited number of physical means of interconnection together with the protocols that enable their use. This will permit the development of interoperable equipment, which does not require translations and gateways to communicate bit streams or files from one unit to another. While the activities to date have been prioritized on local area networks, it is acknowledged that further work is required on wide area networks.

The purposes of a Wrapper (sometimes called a “container”) are to gather together program material (including audio, video, graphics, etc.), called **Essence**, and related information, called **Metadata**; identify the pieces of information; and thus facilitate the placing of information into the Wrapper, the retrieval of information from the Wrapper, and the management of transactions involving the information. Essence and Metadata together form the **Content** of the Wrapper.

The various kinds of information that go into a Wrapper have been defined. The task force considered a range of applications where a Wrapper may be useful, ranging from capture to editing to distribution. Although users prefer a single solution, it was realized that a single Wrapper format will not satisfy all applications, although the number of distinct formats might be limited to just two. It is especially

important for interchange that the different Wrapper formats are defined so that they are compatible. Detailed analysis of the usage profiles for Wrappers must be completed during the development of the formats.

Metadata was identified as a major new class of enablers of systems using bit streams for program material exchange. Metadata is a generic term for all sorts of data captured that relates in one way or another to program material. It ranges from time code and details of technical conditions when material was created to the scripts used, the publicity materials created, and descriptions of shooting locations. It can include standardized descriptive data to help in locating the material through various database entries. This can aid in repurposing of material, thereby significantly increasing its value. A core set of **Mandatory** Metadata items are required to guarantee basic interchange; different core sets will be defined for different uses (for example news acquisition, drama editing, commercial playout). Other Metadata values are optional, and default values may be defined. Metadata must be extensible and be made compatible by registering with a single registration authority.

Specific requirements of Wrappers are defined in the Wrappers section, with additional discussion contained in Annexes D1 through D5.

A great deal has been achieved in the initial efforts to unify technology surrounding the exchange of program material as bit streams. Users and manufacturers alike agree, however, that this is just the beginning, and a similar endeavor should be undertaken for the next step if the organizations that handle standards on a routine basis are to do so in a coordinated way.