

A COPY PROTECTION AND CONTENT MANAGEMENT SYSTEM FROM THE DVB

By Chris Hibbert, Chairman, DVB-Copy Protection Technologies Group

Digital distribution of video and audio (content) into homes and the advent of affordable consumer digital recording and processing equipment and software is increasing both the ease of copying and re-distribution, and the quality of the resulting copies and re-distributed content. This is causing concern amongst rights owners and their licensees about unauthorised copying and re-distribution and the resulting loss of revenue.

The DVB is working towards producing a specification for an open, interoperable, Copy Protection and Content Management (CPCM) system for use in digital broadcasting, consumer products and in-home networks to provide end-to-end protection for content in all processes from the point of initial distribution to the end-user's point of consumption (viewing and listening).

The DVB CPCM system specification is intended to provide a means to prevent unauthorised copying and re-distribution of content whilst also enabling the widest range of new business models, including new methods for the legitimate distribution of content, brought about by the introduction of new compelling consumer products, such as the personal digital recorder (PDR).

DVB Commercial Approach

In September 1999 the DVB established a new sub-group, DVB-CP (Copy Protection) of its Commercial Module with a mandate to prepare commercial requirements for a CPCM system to provide a common framework for the protection and management of content beyond the traditional boundary points of DVB compliant Conditional Access (CA) systems and for the protection of content delivered by free-to-view broadcasters. In particular, the scope of the required system includes in-home digital networks and PDRs. In common with all DVB standardisation work, the goal of DVB-CPCM is an open, interoperable, flexible, industry consensus and market-led specification.

The first step, which was completed in the spring of 2001, was to capture requirements from DVB member organisations and produce a glossary of terms to provide common terminology. The DVB-CP group also developed a **functional model** to check the completeness and self-consistency of its CPCM requirements.

The resulting glossary and commercial requirements were ratified by the parent Commercial Module and the Steering Board of the DVB and passed to the Technical Module (TM) for development. The TM set up a sub group, Copy Protection Technologies (CPT) to undertake this work.

The Stakeholders

The first step in the requirements capture process undertaken by the DVB-CP group was to identify the key stakeholders and constituencies of interest amongst the DVB members.

These comprised:

- rights owners - including representatives of the major movie studios;
- consumer electronics manufacturers;
- broadcasters and platform operators (including both pay and free-to-view services);
- technology providers - including chip manufacturers and CA security technology providers.

Inevitably, viewpoints were initially somewhat polarised between these four industry groups. For example, there was clearly a need to balance the concerns of the rights owners to protect their revenues with the concerns of the consumer electronics industry to protect the investment made by their customers in purchasing equipment. However, despite these differences, requirements captured from the perspective of each constituency showed a great deal of commonality. Thus it was found possible to make progress by building upon the core requirements about which there was consensus whilst setting aside for later analysis and reconciliation those issues about which there was dissent.

The DVB CPCM System

Scope

Although the functionality targeted for DVB-CPCM is much less ambitious than that of a full digital rights management (DRM) system, the scope envisaged remains end-to-end protection for content in all processes from the point of initial distribution to the end-user through to the point of consumption. It is also intended that DVB-CPCM shall be applicable to the widest range of equipment and not just restricted to DVB-specified systems: this encompasses in-home digital networks and personal digital recorders as well as all digital delivery systems such as satellite, terrestrial, cable, and the Internet. If widely adopted the system could be extended to protect content distributed on pre-recorded media.

It is recognised that other DRM and copy protection systems already exist in the marketplace and will continue to be used and developed. Hence to the extent possible, without compromising its integrity and security, DVB-CPCM must co-exist with and interoperate with other DRM and copy protection systems.

DVB-CP Requirements

The DVB-CP sub-group produced an exhaustive list of 45 requirements categorised as follows:

- Environment in which DVB-CPCM is to operate;
- Framework for the requirements including assumptions and dependencies;
- Functionality of the CPCM system, including definition of "Usage States" (see later);
- Performance measures including impact on video/audio quality and delay;
- Security including management of cryptographic secrets (if any required);
- Robustness to transmission errors and trans-coding;
- Compatibility with legacy devices;
- Inter-device interfaces to allow secure exchanges between DVB-CPCM compliant devices;
- Levels and profiles of a DVB-CPCM baseline system.

DVB-CP also produced a comprehensive glossary of 82 terms and 17 abbreviations as an essential step towards creating a shared understanding and description of the requirements.

Functional Model

It was found to be essential to identify a functional model describing how the system would operate – indicating the need for the DVB CPCM system to be self contained and implementable in any equipment to provide “baseline” CPCM functionality but with extensibility, either by future DVB specification or by planned co-existence with proprietary systems.

For DVB-CPCM to be effective in the market place the requirement is for a compliant “module” of functionality to provide copy control mechanisms which can be embedded in all consumer products, from the most basic portable player to the most comprehensive home video systems and including computers with multi-media capabilities.

The bottom line is that DVB-CPCM should benefit from large economies of scale so as to reduce the incremental implementation cost of consumer products to the absolute minimum.

Recognising that future developments in consumer markets will include home networking and remote access it was decided to design the CPCM system to be “network agnostic” This is to preserve the system functionality over time as it is expected that network technologies will be various and evolving; i.e. hard wired or radio; based on existing and developing standards and protocols such as 1394, Ethernet and IP.

It is envisaged that the DVB-CPCM system will comprise a system functional layer containing a "toolkit" of security tools, an Information Manager (handling Usage State and other CPCM information) and a System Manager (handling communications, storage and processing).

An Application Programming Interface (API) is required for device applications which use only the baseline DVB-CPCM system and a CPCM (System) API which will allow the functionality of the baseline system to be expanded using DVB defined standardised enhancements or proprietary CPCM systems (as optional "plug-ins");

A device-to-device interface is identified to enable inter-connection for the transfer of content and CPCM information to and from other DVB-CPCM compliant devices in a network environment.

The Authorised Domain

The DVB-CP recognised that to conform with traditional user experience and expectations based on the portability of pre-recorded content (DVD, CD), whilst maintaining protection against unauthorised redistribution, it is necessary to define an "Authorised Domain" for the use of content in a home networking environment. This requires a means to identify and securely assign devices and networks inside and outside the home uniquely to each other and to a user so that only content legitimately acquired by the user can be consumed within his/her Authorised Domain.

It follows that a means is also necessary to securely bind content to the Authorised Domain if required by the rights owner, or to allow content to be moved “outside” the Authorised Domain if allowed by the rights owner. In cases where content is allowed to be moved outside the Authorised Domain existing copy control rules may still apply.

Such unrestricted movement of content by consumers, where rights of subsequent

consumption in a new Authorised Domain is controllable and securely managed by the rights owner or a licensee is known colloquially as “super distribution” which is seen as a future possible business model.

Usage States

The authorised usage of content protected by the Baseline DVB-CPCM system shall be described by “Usage State Information” (USI) which is tightly bound to the content. Four basic Usage States are defined:

- Copy Control Not Asserted;
- Copy Once;
- Copy No More;
- Copy Never.

It is also a requirement that the Baseline CPCM system shall support a means of indicating whether protected content may be moved for use outside the Authorised Domain, as described above.

Rights owners may also use a "Usage State Extension" to specify additional rules for the authorised usage of content. The coding of such Usage State Extensions may be proprietary (i.e. not specified by the DVB) and capable of being decoded only by the appropriate proprietary plug-in connected to the Baseline CPCM system via the DVB-CPCM system API. Devices which do not have the appropriate proprietary plug-in connected to the Baseline DVB-CPCM system shall interpret content with any such Usage State Extension as "Copy Never".

Revocation

Revocation is included in most DRM/CP systems as a means of eliminating devices which have been compromised and/or pose a risk to the security of the overall system. In DVB-CP it was recognised that a balance must be struck between the rights of the owners of the devices not to be deprived the entire use of their devices and the desire of rights owners to use revocation as an important element of the CPCM toolkit. Accordingly, DVB-CPCM requirements specify that revocation can be used to deny access to specific content rather than to revoke the entire functionality of the device.

End-to-end protection

It is expected that DVB-CPCM will be deployed in the context of a home network as well as in standalone devices and it is recognised that some of the devices in such a network may not be fully compliant with DVB-CPCM. However, to preserve the security of the system, trust should only be given to devices which are fully DVB-CPCM compliant and can signal their compliance. Furthermore, wherever possible, trust should only be given to the necessary nodes in the system - the content source and the final rendering device. Other intermediate devices, or entities such as “dumb” storage, should act as a transparent pass-through of encrypted content and USI. This approach increases security by avoiding the necessity of multiple decrypt and re-encrypt processing as would be the case if each entity, device or linkage comprising a home network was to be considered a standalone element.

The Work in DVB-CPT

A call for proposals (cfp) for CPCM technologies was issued in the summer of 2001. Twenty four wide ranging responses were received, some offering a full solution and some offering specific technological approaches for elements of the envisioned system.

In analysing the CfP responses it became clear that further work was needed to develop

fully the functional model of the envisaged DVB-CPCM system to provide a coherent framework for analysis.

Rather than attempt to select a solution at the time, as the responses were wide ranging, the CPT group elected to develop Technical Requirements for DVB CPCM to further identify required functionality and against which to assess the available technologies.

Hence the work of the DVB-CPT sub-group initially focused on developing the functional model through two strands of work:

- development of usage scenarios;
- technical design.

Accordingly two working groups were created:

- The Usage Scenarios (SCEN) group produced a number of scenarios applying to devices containing CPCM in the home environment, starting with the simplest case of a single integrated digital TV receiver and working up to a home network with multiple devices. This group also developed, through example scenarios, the concept and definition of the Authorised Domain.
- The Layered Technical Design (LTD) group started to develop a specification framework for the technical infrastructure for DVB-CPCM based upon the ISO/OSI Layer Model assuming that the inter-device communication and network environment is established by other specifications and concentrating on the additional and specific communications and functionality required for the DVB-CPCM system.

The two groups worked separately but regularly combined their outputs to synchronise and stabilise their assumptions and terminology.

Latterly a drafting group has been formed charged with editorial responsibility for the Technical Requirements documents.

The output of the SCEN group will also be used to benchmark the progress of the LTD group and to check the completeness of the overall DVB-CPCM specification finally proposed.

A crucial stage has been to fully technically define the characteristics of the Authorised Domain. This is key work as this novel concept is the fulcrum of the DCB-CPCM concept and the CPT group has spent many months deliberating a number of challenging issues which again has exposed significant differences between the constituencies of interest. At the time of writing this difficult stage is nearing completion of the first pass with a growing awareness between the contributing parties that only a consensus based solution will work for the industry as a whole.

Some of the Challenges

To preserve content rights whilst recognising the expectations of consumers, the following technical restrictions to the Authorised Domain are under consideration:

- Restriction of remote access to preserve rights of consumption of content which is restricted to the geographic area of initial distribution
- Limiting the size (number of devices) in the Authorised Domain to prevent abuse of the rights of consumption in terms of number of people, locations, simultaneous viewings.
- How to manage assignment of content and equipment Domain membership during the process of aggregation and separation of devices in an Authorised Domain.

All the above must take place automatically and without complication for the consumer as it is a commercial requirement that DVB CPCM must operate without the intervention of a controlling entity and must not be dependant on the availability of a return path

The end game?

There are a number of national and international groups working towards specifications for standardised DRM systems and a large number of proprietary DRM systems competing in the marketplace. It is likely to be some time before an agreed specification for a full DRM system emerges, either through formal standardisation processes or through the emergence of a dominant proprietary system. In the meantime there is an urgent need for a basic, open interoperable Content Protection and Content Management (CPCM) System.

Towards this objective, the DVB-CP sub-group has successfully captured the requirements for CPCM in DVB and related environments and, building upon this foundation, the DVB-CPT sub-group of the Technical Module is now making good progress towards an overall technical specification for an open interoperable CPCM system.

Ultimately the success or not of the CPT group will be apparent when the resulting specification is assessed against the original commercial requirements. This process will also inevitably re-introduce some of the contentious, unresolved issues which came out of the initial commercial requirements capture process.

The time scales are therefore difficult to predict but the long term objective is for DVB to be in a position to lodge its CPCM specification with a European standards agency, such as ETSI, so that the industry can benefit from the achievement of the consensus driven open standards approach for which the DVB is known to be successful.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of over 300 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries committed to designing global standards for the delivery of digital television and data services.

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