The *TV-Anytime* Forum

Specification Series: S-2

On:

System Description

(Informative)

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Series Overview

This is the second in a series of five "S-series" documents produced by the *TV-Anytime* Forum. These documents establish the fundamental specifications for the services, systems and devices that will conform to the *TV-Anytime* standard, to a level of detail that is implementable for compliant products and services.

As is common practice in such standardisation efforts, these specification documents were preceded by requirements documents ("R-series"), which define the requirements for the *TV-Anytime* services, systems, and devices.

Congruent with the structure defined in *TV-Anytime*'s Call for Contributions (TV014r3), these specifications are parsed into three major areas, each described in a separate document of the series: Metadata (S-3), Content Referencing (S-4) and Rights Management (S-5). See the Call for Contributions for more detail on the derivation and background of these categories and their respective roles in the *TV-Anytime* standardisation process.

The other two documents in the S-series are intended to define the environment and system architecture in which the standards in S-3, S-4, and S-5 are to be implemented. The first document in the series (S-1) provides benchmark business models against which the *TV-Anytime* system architecture is evaluated to ensure that the *TV-Anytime* standard enables key business applications. This document in the series (S-2) presents the *TV-Anytime* System Architecture. These two documents are placed ahead of the other three for their obvious introductory value; S-1 and S-2 are both informative.

Although each of the S-series documents is intended to stand alone, a complete and coherent sense of the *TV-Anytime* system standard can be gathered by reading all five of the specification documents in numerical order.

System description specification S-2
Document Revision History

Version	Status	Date	Author	Comments
1.0	Final Specification	15/12/2000	System Design Group	Published as SP002 v1.0
1.1	Final Specification	22/6/2001	System Design Group	Published as SP002v1.1

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About the TV-Anytime Forum

The global *TV-Anytime* Forum is an association of organisations which seeks to develop specifications to enable audio-visual and other services based on mass-market high volume digital storage in consumer platforms – simply referred to as *local storage*.

The *TV-Anytime* Forum was formed at an inaugural meeting held in Newport Beach, California, USA, on 27-29 September 1999. It has started work to develop open specifications designed to allow Consumer Electronics Manufacturers, Content Creators, Telcos, Broadcasters and Service Providers to exploit local storage.

As part of its formation, the *TV-Anytime* Forum has established four fundamental objectives for the organisation, which are:

- The *TV-Anytime* Forum will define specifications that will enable applications to exploit local persistent storage in consumer electronics platforms.
- The *TV-Anytime* Forum is network independent with regard to the means for content delivery to consumer electronics equipment, including various delivery mechanisms (e.g., ATSC, DVB, DBS and others) and the Internet and enhanced TV.
- The *TV-Anytime* Forum will develop specifications for inter-operable and integrated systems, from content creators/providers, through service providers, to the consumers.
- The *TV-Anytime* Forum will specify the necessary security structures to protect the interests of all parties involved.

Member organisations from Europe, the USA, and Asia, are drawn from a wide variety of industries: Traditional Broadcasters, Internet Broadcasters, Content Owners, Service Providers, Telcos, Consumer Electronics Manufacturers, IT Industries, Professional Equipment Manufacturers, Component Manufacturers and Software Vendors.

The *TV-Anytime* Forum invites *participation* from all interested organisations. Membership is open to all who sign the Memorandum of Understanding and attend meetings. Meetings are held approximately every two months in Europe, the USA, and Asia.

For more information or to get involved with the work of the *TV-Anytime* Forum, visit the *TV-Anytime* Forum (www.tv-anytime.org) or contact:

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1. Scope

This TV-Anytime specification shows the system behaviour of a TV-Anytime broadcast system with an interaction channel used for consumer response. It focuses on the use of the TV-Anytime content reference specification in combination with the TV-Anytime metadata specification in a system context. The specification will show examples of how to use both specifications both from static and dynamic viewpoints, i.e., it will highlight the parties involved in the processes and show the interaction between them. The specification will **not** show the use of rights management in the system: the TV-Anytime Rights Management specification will be included as soon as it is finalised.

To understand this specification, it is necessary for the reader to understand 'TV-Anytime Requirements document R-2: the System Description'. Since this specification applies 'TV-Anytime specification S-4: Content referencing specification V1.0' and 'TV-Anytime specification S-3: Metadata specification v.1.0' those documents are recommended reading. Both specifications enable the features in Table 1-1 that will be highlighted in a system context in this document.

The nature of this specification is that of a cookbook or white paper to the TV-Anytime S-4 v1.0 and TV-Anytime S-3 v1.0 specifications. It is an informative specification and has therefore not the intention to mandate certain system implementation solutions. Preferred solutions from a technology standpoint will be indicated to allow implementers to build efficient systems. Normative requirements that follow from writing this specification are inserted in the previously mentioned specifications.

This document is the second of a series of gradually more complete system descriptions, enabling developers to make the most of TV-Anytime tools. Future versions of this specification will show more complete TV-Anytime system behaviour like the use of rights management & protection tools.

Table 1-1 Enabled feature set by S-4v1.0 and S-3v1.0r1

Model 1 – Broadcast Model	
Use of ECG to find and capture broadcast content	X
Capture and playback of audio, video and data (AVD)	X
Cross linking of A/V content to related content	x[1]
Support of consumer preferences	X
Content can be updated/replaced by newer in-coming versions	x[2]
Support for a variety of broadcast content types	x[3]
Support for all broadcast delivery mechanisms	X
Multi-user preference support	X
Model 2 – Consumer Response Model	
Updated listing/capture data can be delivered to 'broadcast' analog personal recorders (via return path or other mechanism)	X
Updated listings/capture data can be delivered to 'broadcast' PDRs	X
Verification of usage of content on PDR	x[4]
Ability to collect usage data	X

X= fully supported, x = partly supported

[1] Various types of content can be cross-linked using MediaLocator (see Metadata specification S-3.) The program metadata does not contain a CRID for cross-linking to other programs.

[2] Entire programs can be overwritten, but segments of programs cannot be overwritten.

[3] See the Metadata specification (S-3) for a list of supported content types.

[4] Access to usage data is not specified by the current tools.

2. Glossary of Terms

Acquisition	Retrieval of content
Attractor	A metadata element that is accessible by the consumer in order to aid in the content selection process, thus attracting the consumer. Examples include the title and name of an actor in a television program
Bi-directional	A system that allows a two-way flow of content and/or information
Data Carousel	A method for transmitting data over a broadcast channel in which data is cyclically transmitted
Capture	Storing the acquired content (to local storage)
Consumer Profile	Data that represents the interests & preferences of the consumer
Content	Anything the viewer would like to consume (e.g., movies, games, TV programs, radio programs etc.)
Content Creator	The producers of the content
Content Provider	An entity that acts as the agent for and is the prime exploiter of the content
Content reference	A pointer to a specific content item
Control Flow	System related data e.g., consumer queries, transactional information, device capabilities, profile information etc.
Functional unit	Basic logical element, implementing a defined function of a TV-Anytime system
Location Resolution	The process of establishing the address (location and time) of a specific content instance from its CRID
Metadata	Generally, data about content, such as the title, genre, and summary of a television program. In the context of *TV-Anytime*, metadata also includes consumer profile and history data

2.1 Abbreviations

CFC	Call for Contributions
CRID	Content Reference IDentifier, an identifier for content that is independent of its location specified by TV Anytime S-4: Content reference specification
EPG	Electronic Program Guide: A means of presenting available content to the consumer, allowing selection of desired content
IPR	Intellectual Property Rights
ISAN	International Standard Audiovisual Number
ISO	International Organisation for Standardisation
PDR	Personal Digital Recorder
SMPTE	Society of motion picture and television engineer
QoS	Quality of service
V-ISAN	Versioned-International Standard Audiovisual Number

3. TV-Anytime broadcast system architecture

A simple TV-Anytime broadcast system can be viewed as containing three major elements: a service provider delivering the TV-Anytime service, a transport provider that carries the service and a piece of equipment in the home that stores the content and plays it back at the consumer's request. The 'TV-Anytime R-2: System Description' document examines the mechanisms behind this simple model and gives a comprehensive functional reference model. This model adapted for the pure broadcast situation is depicted in Figure 3-1. In this figure, a clustering of functions is indicated that is especially relevant in the broadcast case: it shows the 'PDR' (personal digital recorder).

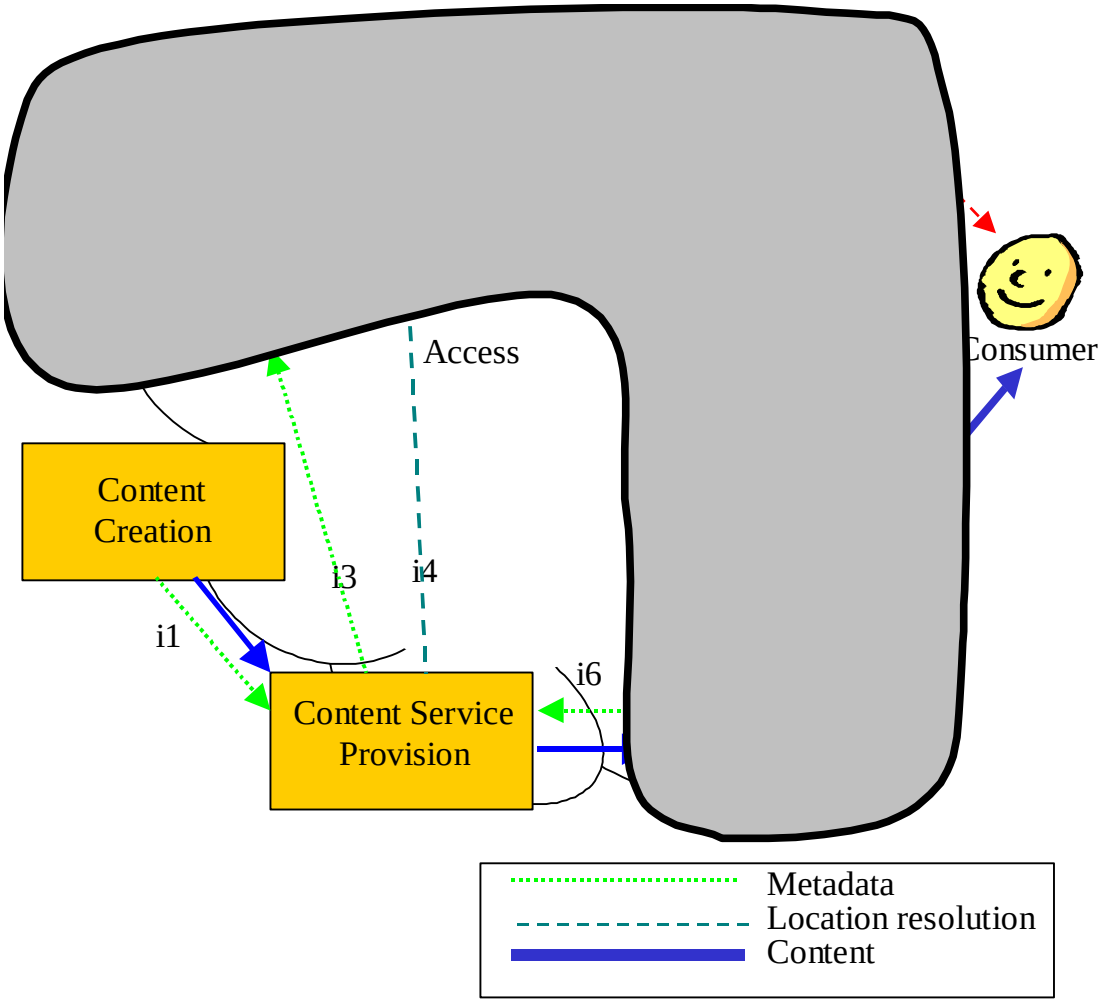

Figure 3-1: Broadcast model without rights management protection

Each of the boxes in the model is a function of the TV-Anytime system, and can be implemented in several different ways by several different service providers. Different physical implementations of the system will have different ordering of functionality in different physical devices (possibly in different locations). The 'TV-Anytime R-2: System Description' gives a detailed description of possible system configurations. The arrows in the figure indicate information flows between functions, a complete description of these flows can also be found in the 'TV-Anytime R-2: System Description' document.

The broadcast model with a narrowband bi-directional channel supports the feature set listed in Table 1-1. It is a pure broadcast model as far as content and associated data is concerned. In this broadcast model only three system functions are external to the PDR: content creation, content service provision and access. The bi-directional green link between user and service provider can be used to get usage history data or preference data from a consenting user. A movie studio or entertainment company could fulfil the role of content

creator. A broadcaster would typically handle the repackaging, addition of metadata and broadcasting of the content: the content service provision function. A cable or satellite operator typically provides the access. The remaining functions reside in the PDR. The PDR can be considered as a real device at the consumer's premises that allows him to store and view content. In Figure 3-1 the PDR is the grey area encompassing functions search and navigation, location resolution, user interaction, content presentation and local storage management.

This system will allow the user to search, select, locate and acquire content that he likes. The search and selection, e.g., by an EPG, will be on the basis of broadcast metadata that advertises the available content. One or more parties can put this metadata in the broadcast: the broadcaster, the content creator or a third party. The third party is not modelled in Figure 3-1. An extension of this model showing third party operation will be discussed in the next chapter.

The search and navigation will result after user- or automatic selection in a content reference ID (CRID). The resolution function in the PDR, using the previously obtained content reference ID, results in a physical location of the content (e.g., a particular channel & time). Location resolution data must have been broadcast to allow the PDR to actually perform this translation from reference ID to in this example physical channel and time. The interfaces on the PDR will be subject to the appropriate rights management and protection policies that will be defined in a later version of the TV-Anytime specification series.

3.1 Content referencing rationale

The purpose of content referencing is to allow acquisition of a specific instance of a specific item of content. For example, if a consumer sees an announcement on TV saying "there'll be a new series on "Foxes in the cold" around Christmas", he may want to instruct his Personal Digital Recorder (PDR) to record the whole series. However the actual time and channel of airing of the episodes might be unknown to the PDR. In fact, the broadcaster may not know yet either. Still the viewer will want to make sure at this point that he does not miss the opportunity to acquire the content.

The ability to refer to content (in this example a series of programs) independent of its location will provide this capability desired by the consumer. Whether that location is on a particular broadcast channel on some date and time, or on a file server connected to Internet, or wherever.

In this example, the PDR system would be provided with a reference for the series. In due time, the information required to link this reference to the individual episodes will be supplied to the PDR. Subsequently a specific date and time for each episode so that the PDR would be able to acquire all of them.

This example demonstrates the purpose of content referencing – to provide the ability to refer to content independent of its location, and the ability to subsequently resolve such a reference into one or more locations where the content can be obtained.

3.2 Metadata rationale

Users or user-agents want to choose programmes to watch or record. To make that choice they need information like what is the title of this programme, what is it about, who are the actors, is it sci-fi? On the other hand, programme makers want to attract users to their content, by providing similar information. That is where metadata comes in: it is descriptive data about the content the user wants to consume. TV-Anytime content-related metadata is based on that assumption and is therefore largely 'attractor' metadata, its goal being to provide choice to the user and means to service providers to advertise their content and services.

The following chapter, Chapter 4 of this specification describes content referencing and the actors involved. Chapter 5, of this specification describes the available metadata tools and their uses. An example walkthrough and specific comments describing the dynamic system behaviour in the different phases of a TV-Anytime service lifecycle are described in Chapter 6.

4. TV-Anytime Content Referencing Scenarios

This chapter introduces key concepts of content referencing, an extension of the static reference model introduced in the previous chapter to model third party operation and possible scenario's of issuing and resolving references to items of content.

4.1 Content referencing key concepts

The key concept in content referencing is the separation of the reference to a content item – the CRID – from the information needed to actually retrieve the content item – the locator. The separation provided by the CRID enables a one-to-many mapping between content references and the locations of the deliverables. From a system perspective, content referencing and resolution lies between search and selection and actually acquiring the content. From the content referencing perspective, search and selection yields a CRID, which is resolved into either a number of CRIDs or a number of locators (the number may be one). A full discussion of content referencing is beyond the scope of this document; rather it is the intention here to show how content referencing fits into the overall system. In the examples below, the syntax of a CRID and the syntax of a locator are employed. The syntax of a CRID is:

CRID://<authority>/<data>

Where <authority> takes the form:

<DNS name><path>

The syntax of the locator is:

<transport mechanism>:<transport system specific>

The content referencing mechanism employs two key tables. The first is the Resolving Authority Record Table that maps the authority that issued the CRID to the Resolution Service Provider. The second table is the actual Resolution Table, which maps a CRID to another CRID or to a location. Refer to 'TV-Anytime specification S-4: Content referencing specification' for a more detailed explanation of the concepts and tables involved.

4.2 Content referencing and unique content identification

Content referencing is the process of associating a token to a piece of content that represents its location where the content can be acquired. It is different from content identification, which creates an identifier that is the same regardless of its location.

A content reference is the token that is used by the PDR to acquire a piece of content once the user (or an agent working on their behalf) has selected it. The content reference is the "way pointer" from selection to acquisition.

A content identifier is an identifier that is created at the point just after the content is created with the idea that this identifier will always stay with the content. It allows metadata from multiple sources to all refer to the origination of the content. Whilst very useful, a content identifier is not designed for aiding acquisition of the content as it would require the (possibly globally centralized) body that created the content identifier to know about every instance of the content, and to be informed every time any of these locations change.

As there are already technologies being designed to fulfill the requirements of a content identifier, the TV Anytime forum have chosen to design a content referencing token as this is an area that requires a global open standard.

The TV Anytime specification uses the CRID as its token to represent the location of content. The CRID can be converted into either more CRIDs, or actual locations, by the process of location resolution.

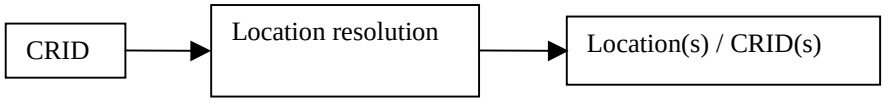

Figure 4.1: The Location Resolution Process

The idea of a CRID being able to refer to other CRIDs is so that a CRID can represent a grouping of content (which is something that a content identifier cannot do). The group CRID can be used for representing any arbitrary group, an example of which is an entire series. A group CRID for an entire series would allow the PDR to acquire an entire series of programmers by just selecting one CRID to acquire.

One feature of the group CRID is that it means that many CRIDs may resolve to the same piece of content (as the content may be a member of many groups) which means that there might not be one unique CRID per content item.

The TV Anytime defined CRID contains information about how to carry out the location resolution process. All CRIDs contain two parts, the first part is called an authority (which is the body that created this CRID) and the second part is data that has been created by the authority. A piece of information called the resolution authority record provides the mapping of resolution authority to the place where location resolution can take place.

An important feature of the TV Anytime defined CRID is that it does not require a globally centralized body to assign CRIDs, as this was felt was impractical in that it may not scale well (e.g., in an Internet equipped PDR). From talking with various broadcasters it was also discovered that an advantage of a non-global registration system is that it allows material already in a broadcaster's catalogue to be broadcast without needing to register a globally unique identifier.

Another advantage of a de-centralized system is that the user can choose which authority that is closest to their personal tastes. For example one authority can choose that two programs are the same, but another authority can specify that they are different. E.g., one is a widescreen presentation and the other is a pan and scan presentation of the same film, and the user can pick the authority that matches their personal views (i.e., they might consider widescreen and pan and scan versions identical).

4.3 CRID issuing Authority and resolution providers

The originator of a CRID is the party that actually creates the CRID and assigns it to reference an item of content: the Authority. The resolution provider is the party that provides the facility to resolve the CRID into a physical location in space and time. Three main actors can originate and resolve content reference identifiers: content creators, content service providers, and 3rd parties. Third parties are not shown in Figure 3-1 but can be modelled in quite easily. The next section will describe the amended model, after that the possible combinations of actors are discussed.

4.3.1 3rd party extension to static reference model

Table 4-1 shows possible actors in the issuing and resolving of CRIDs. Two of those actors are already in the broadcast reference model shown in Figure 3-1: the content creator and the content service provider. Third party operation is not explicitly modelled in Figure 3-1. However, the model can be easily extended to cater for third party provisioning, both for CRID and resolution data, as well as metadata. In Figure 4- this extension is depicted. Only the existing interfaces are modelled in this figure. There may be a need for interfaces between the different functions in the content service provision function e.g., to enable the export of broadcasting schedules to the metadata provisioning function. Interfaces like that may be covered by future version of the TV-Anytime specification.

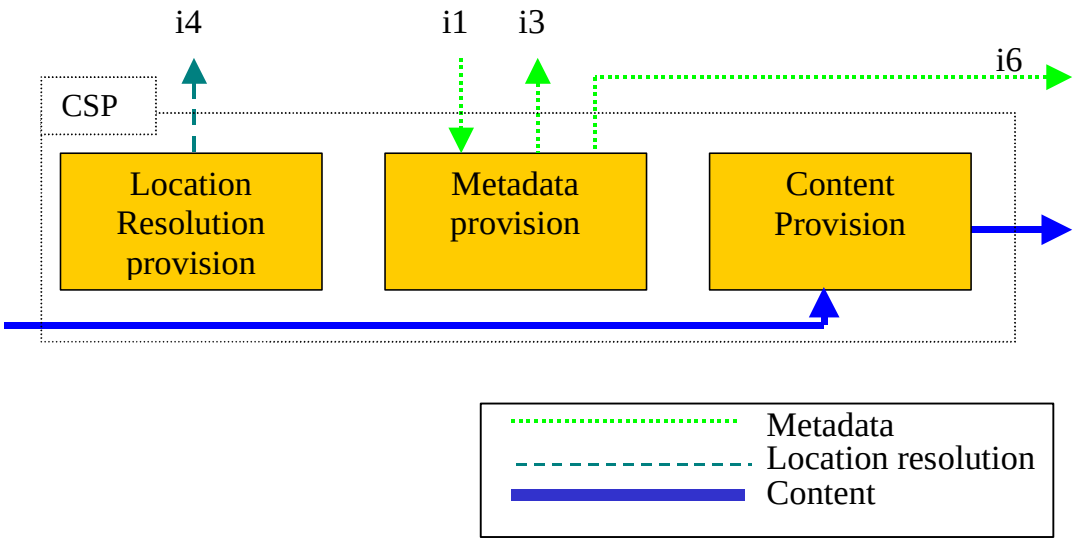

Figure 4-2 Extension to static reference model

The content service provisioning function in the overall model of Figure 3-1 is split up in a number of different functions: a location resolution provision function, a metadata provision function, and a content provision function. For example in a service broadcast by broadcast XYZ, where XYZ is provisioning the repackaged content, there could be metadata from a third party with more extensive descriptions of XYZ content. This metadata could also be linked to CRIDs describing a different clustering of content: e.g., all episodes of a series with a certain actress in them. That same party could provide accompanying location resolution data for those CRIDs as well.

4.4 CRID issuing and resolving scenario's

In the most straightforward scenario, the originator of a CRID is also the resolution authority for that CRID. However, this relationship does not always hold. There are a number of scenarios where the CRID originator does not resolve the CRID itself. Table 4-1 depicts all possible CRID originators to CRID resolution authority scenarios. The table shows which are likely and which are unlikely in the pure broadcast case. Unlikely in no way implies an impossible scenario.

Table 4-1 Originator of a CRID versus resolution of a CRID in pure broadcast case

	Content Creator resolves CRID	***Content Service Provider resolves CRID***	***3rd Party resolves CRID***
Content Creator originates CRID	Likely	Likely	Likely
Content Service Provider originates CRID	Unlikely	Likely	Unlikely
3rd Party originates CRID	Unlikely	Likely	Likely

The following sections describe the different likely scenarios in more detail.

4.4.1 CRID originated by content creator, resolved by content creator

In this simple scenario, the content creator creates the content and creates a CRID to reference that piece of content. The content creator also provides the resolving information to find that particular piece of content.

In the broadcast case, suppose the content creator is not the broadcaster, and the content in question is a drama entitled “Most Moving Drama Ever”. The authority syntax might then be:

content.com;drama

The CRID itself might take the form:

CRID://content.com;drama/MostMovingDramaEver

The string “MostMovingDramaEver” is meaningful to the authority, i.e., the authority will be able to resolve this CRID when it is asked to do so. The content creator, having created the drama programme and having assigned it a CRID, needs to be able to broadcast the location resolution information to the PDR. This means it needs to have access to the broadcast channel and schedule information of the relevant broadcaster(s) involved. In the pure broadcast scenario, because there is no return channel, the location resolution takes place in the PDR itself. Finally, the content is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

When the broadcaster is also the content creator the scenario is simpler and described in Section 4.4.4.

4.4.2 CRID originated by content creator, resolved by content service provider

In this scenario, the content creator creates the content with an associated CRID. The content service provider is the resolution service provider.

Supposing the content creator is a motion picture studio, and the content in question is an action movie entitled “Best Action Movie Ever”. The content service provider is a broadcaster. In this case the content service provider is acting as a proxy for the content creator. The content creator creates a CRID. It might look like this:

CRID://moviestudio.com;movies/BestActionMovieEver

The broadcaster, having purchased the movie from the studio for airing and having also acquired the CRID, broadcasts the location resolution information to the PDR. This information is contained in the ‘Resolution Tables’ that map the CRID to the location. Also broadcast to the PDR are the Resolution Authority Records, one of which effectively includes a redirect, a record where the authority name and resolution service provider are different. In this example there is a Resolving Authority Record where the authority name is ‘moviestudio.com/movies’ and the resolution provider is ‘broadcaster.com’.

In a uni-directional network, the location resolution takes place in the PDR. The consumer selects “Best Action Movie Ever” during some navigation or search process. The location resolution engine, having looked up the appropriate Resolving Authority Record, resolves the CRID whose authority is ‘moviestudio.com/movies’ by using the resolution service provider ‘broadcaster.com’. The resolution service provided by ‘broadcaster.com’ resolves the CRID to the actual location, the time and channel of the broadcast in the context of the service provider.

Finally, the movie is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

4.4.3 CRID originated by content creator, resolved by 3rd party

In this scenario, the content creator creates the content and associated CRID. A third party resolves the CRID.

Supposing the content creator is a documentary production company, and the content in question is a documentary entitled “Incredible Documentary”. This documentary will be carried by several broadcasters over a period of time. In terms of location resolution the 3rd

party is acting as a proxy for the content creator. The production company creates a CRID. It might look like this:

CRID://documaker.com/IncredibleDocumentary

The 3rd party might be an Electronic Content Guide service. The advantage of the 3rd party in this case is that it can look across all service providers in the multiplex to resolve a CRID. The 3rd party inserts the location resolution tables into the broadcast stream. Also inserted into the broadcast stream are the Resolving Authority Records, one of which contains the authority name 'documaker.com' and the resolution service provider 'res-service.ecg.com'.

In a uni-directional network, the location resolution takes place in the PDR. The consumer selects "Incredible Documentary" during some navigation or search process. The location resolution engine searches the table of Resolving Authority Records and finds the one whose authority name matches the authority name in the CRID, in this example 'documaker.com'. The engine then uses the URL contained in the record to find the actual location resolution tables. In this way the CRID is resolved to a locator e.g.,

transport:channel5@8.00

Finally, the content is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

4.4.4 CRID originated by content service provider, resolved by content service provider

In this scenario, the content service provider acquires content and assigns its own CRID to reference that content. The content service provider is also the resolution service provider.

The content service provider could be a broadcaster, and the content in question is the movie "Best Action Movie Ever" from a motion picture studio. The motion picture studio, the content creator, may very well have its own CRID referencing the movie, but the content service provider decides not to use this. The broadcasters CRID might look like this:

CRID://broadcaster.com;movies/BestActionMovieEver

The broadcaster inserts the location resolution tables into the broadcast stream. Also inserted into the broadcast stream are the Resolving Authority Records, one of which contains the authority name 'broadcaster.com;movie' and the resolution service provider 'broadcaster.com;movie'.

In a uni-directional network, the location resolution takes place in the PDR. The consumer selects "Best Action Movie Ever" during some navigation or search process. The location resolution engine searches the table of Resolving Authority Records and finds the one whose authority name matches the authority name in the CRID, in this example 'broadcaster.com/movie'. The engine then uses the URL contained in the record to find the actual location resolution tables. In this way the CRID is resolved to a locator, e.g.:

transport:channel9@21.30

Finally, the content is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

4.4.5 CRID originated by 3rd party, resolved by content service provider

In this scenario, a 3rd party service creates e.g., a group CRID that references other CRIDs that in turn reference actual content. The 3rd party could be an aggregator of some description. The content service provider agrees to be the resolution service provider for this 3rd party because the 3rd party service is particularly valuable.

Suppose the 3rd party provides a CRID referencing all episodes of the "Star Journey" science fiction series. The CRID might look like this:

CRID://StarJourneyAggregator.com/AllEpisodesOfStarJourney

The broadcaster provides a Resolution Authority Record containing the authority name 'StarJourneyAggregator.com' and the resolution provider 'broadcaster.com'.

The consumer, using some search and navigation process comes across the "All Episodes of Star Journey" item. The PDR looks up authority it finds in the CRID for this item. It finds that the resolution service provider is 'broadcaster.com' and uses the URL to find the resolution tables. It resolves the CRID into a list of other CRIDs:

CRID://broadcaster.com/StarJourneyEpisode1

CRID://broadcaster.com/StarJourneyEpisode2

CRID://broadcaster.com/StarJourneyEpisode3

In this example, the returned CRIDs were issued by the broadcaster, however the third party could also have its own CRIDs for these episodes that a broadcaster knows how to resolve.

The various episodes are presented to the viewer for selection. The viewer selects "Star Journey Episode 2" and again the engine looks up the authority name in the Resolving Authority Record table. It finds that authority name 'broadcaster.com' maps to resolution provider 'broadcaster.com', and subsequently resolves the CRID to a list of alternate locations e.g.:

transport:channel9@21.30

transport:channel5@9.15

The most appropriate location is chosen depending on such factors as how soon the viewer wishes to watch the programme, recording conflicts if the programme is to be saved to local storage, the cost of one location versus the other etc.

Finally, the content is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

4.4.6 CRID originated by 3rd party, CRID resolved by 3rd party

In this scenario, a 3rd party service creates e.g., a group CRID and references other CRIDs that in turn reference actual content. The 3rd party is an aggregator of some description. The same or another 3rd party is also the resolution service provider.

Suppose the 3rd party provides a CRID referencing all nature documentaries on all channels within a multiplex. The CRID might look like this:

CRID://Aggregator.com/AllNatureDocumentaries

The 3rd party provides a Resolution Authority Record containing the authority name 'Aggregator.com' and the resolution provider 'Aggregator.com'. This is broadcast to the PDR along with the resolution tables, tables that the 3rd party collates from schedule metadata it collects from all the content service providers in the multiplex.

The consumer comes across the "All Nature Documentaries" item in their Electronic Content Guide. The PDR looks up the authority it finds in the CRID for this item. It finds that the resolution service provider is 'Aggregator.com' and uses the URL to find the resolution tables. It resolves the CRID into a list of other CRIDs:

CRID://Aggregator.com/FoxesInTheWild

CRID:// Aggregator.com/OceansOfTheWorld

CRID:// Aggregator.com/TheMapleTree

The various programmes are presented to the viewer for selection. The viewer selects "Oceans of the World" and again the engine looks up the authority name in the Resolving Authority Record table. It finds that authority name 'Aggregator.com' maps to resolution provider 'Aggregator.com', and subsequently resolves the CRID to a list of alternate locations e.g.:

transport:channel2@17.30

transport:channel7@21.00

The most appropriate location is chosen depending on such factors as how soon the viewer wishes to watch the programme, recording conflicts if the programme is to be saved to local storage, the cost of one location versus the other.

Finally, the content is broadcast and can be recorded on the local storage device and consumed later, or can be viewed at the time of broadcast.

4.5 Example of coding a ISAN or V-ISAN using a CRID

The ISO and SMPTE/ATSC have been actively working on the creation of a Versioned-International Standard Audiovisual Number (V-ISAN), which builds on ISO's original concept of an International Standard Audiovisual Number (ISAN). The goal of the new V-ISAN is to uniquely identify completed audio-visual works. In contrast with a CRID, the V-ISAN remains the same regardless of the provider of that content and would further allow comparisons between V-ISANs to determine that two pieces of content differ only by being a different version of the same root work or are different episodes of the same series.

The TV Anytime Forum recognises that some metadata and content providers have expressed interest in using the ISAN or the V-ISAN to identify the programs they provide or reference in metadata. As such, the following CRID format is proposed to enable a CRID to be built using a known ISAN or V-ISAN.

An example CRID incorporating an ISAN will look like:

CRID://<authority>/isan<ISAN according to ISO 15706>

An example CRID containing a V-ISAN will look like:

CRID://<authority>/v-isan<V-ISAN according to ISO 20925>

In these examples the <authority> portion is as specified in SP004v1.0 and the <data> portion of the CRID is a (V-)ISAN, prefixed with the fixed string "isan" or "v-isan", respectively. In this case the normal use and semantics of the CRID are preserved. Namely, to convert this CRID into one or more location records the PDR contacts a location resolution service serving the Resolution Authority named in the <authority> portion of the CRID and passes the <data> portion, which in this case is a (V-)ISAN. However, because the data portion is clearly identified as a (V-)ISAN it also enables the PDR to make comparisons between CRIDs to determine if the referenced content is identical, different by version, or different by episode.

It is important to note that there is a significant difference between a CRID that is issued by a resolution authority and one that is constructed by the user interaction functionality in the PDR. There is an intention that a CRID that is issued will always be resolved by the relevant authority, whereas resolution of a constructed CRID is entirely speculative: one cannot rely on getting the location of the requested content.

Any unique ID for content can be used in a similar way as the (V-)ISAN in the above examples.

The next chapter will introduce the current metadata specification (v1.0r1).

5. Metadata

5.1 Introduction

Metadata is generally defined as "data about data". Within the *TV-Anytime* environment, the most visible parts of metadata are the attractors/descriptors or hyperlinks used in electronic program guides, or in Web pages. This is the information that the consumer or agent will use to decide whether or not to acquire a particular piece of content.

The *TV-Anytime* metadata system allows the consumer to find, navigate and manage content from a variety of internal and external sources including, for example, enhanced broadcast, interactive TV, Internet and local storage. It defines a standard way to describe consumer profiles including search preferences to facilitate automatic filtering and acquisition of content by agents on behalf of the consumer.

There is a need to associate metadata with content to facilitate human and automated searching for content of interest. Such metadata includes descriptive elements and attractors to aid the search process as well as elements essential to the acquisition, capture and presentation processes; content rights, formats, duration, etc. Many of these descriptive elements can be found in electronic program guides and Web pages.

The process of creation and evolution of metadata for an individual content item may involve many organizations during the course of creation, distribution and delivery to the consumer. Thus, there is a clear need to define a common metadata framework and a standard set of metadata elements in order to ensure a high level of interoperability within the chain from content creation to content delivery.

5.2 XML – a common representation format

For the purpose of interoperability, the TV-Anytime Forum has adopted XML Schema as the common representation format for documentation of metadata. XML offers many advantages: it allows for extensibility, supports the separation of data from the application, and is widely used. In addition, powerful XML tools are now available such as XSL (XML Stylesheets), XQL (XML Query Language), and XML databases that can be used to process and manage XML data. As a textual format, XML tends to be rather verbose; however, a number of mechanisms are being developed to reduce the bandwidth when necessary. It is important to note that the XML representation of a TV-Anytime document is just that, *a representation*. It is *one possible representation of the metadata*; it is not the only representation of the metadata. There is no assumption that TV-Anytime metadata must be represented in XML format. Metadata could be represented by an optimized binary format to conserve bandwidth and aid rapid processing and mapping to a database. It is strongly recommended that if XML is used as exchange syntax for TV Anytime metadata, then that XML should conform to the TV-Anytime Schema. This has obvious advantages in the business-2-business realm in addition to the business-2-consumer realm.

The following sections introduce the TV-Anytime metadata schemas. They also provide snippets of XML instance documents. Basic knowledge of XML is needed in order to understand the following sections.

5.3 The TV-Anytime metadata high level documents

All TV-Anytime metadata instance documents are grouped under a root element called “TVAMain”.

5.3.1 Metadata Structure

There are three basic kinds of metadata that a “TVAMain” element groups:

- Content description metadata
- Instance description metadata
- Consumer metadata

The diagram in Figure 5-1 illustrates this relationship.

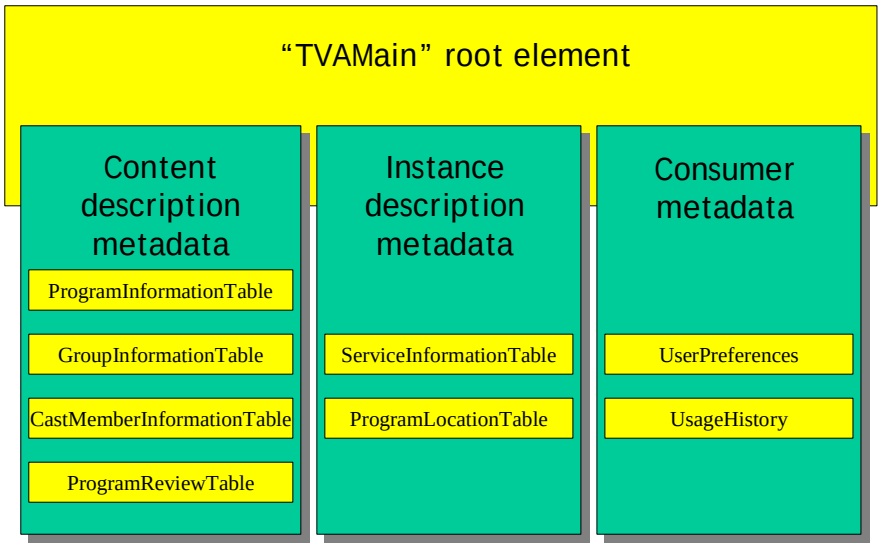

Figure 5-1 TV-Anytime documents with "TVAMain" as root element

5.3.2 Content Description Metadata

Content Description metadata is divided into four areas:

1. Descriptions of items of content e.g., television programmers. These descriptions are held in the ProgramInformationTable. They include things like the title of the program, a synopsis, the genres it falls under and a list of keywords that can be used to match a search. The following example is a ProgramInformationTable containing a single ProgramInformation element. The example is not exhaustive.

```
<ProgramInformationTable>
 <ProgramInformation ProgramId="crid://hbc.com/foxes/episode11">
  <BasicDescription>
    <Title type="main">
      The one where Fox jumps in the Potomac
    </Title>
    <Synopsis>
      Fox goes to Washington and jumps in the Potomac
    </Synopsis>
    <Keyword>Fox</Keyword>
    <Keyword>Washington</Keyword>
    <Keyword>Potomac</Keyword>
    <Genre type="main">Comedy</Genre>
  </BasicDescription>
  <OtherIdentifier>102330002211</OtherIdentifier>
  <MemberOf>crid://hbc.com/foxes/all</MemberOf>
 </ProgramInformation>
</ProgramInformationTable>
```

2. Descriptions of groups of related items of content e.g., all episodes of "Foxes in the Wild". These descriptions are held in the GroupInformationTable. The following example is a GroupInformationTable containing a single ProgramInformation element. The example is not exhaustive.

```
<GroupInformationTable>
  <GroupInformation GroupId="crid://hbc.com/foxes/all">
    <BasicDescription>
      <Title type="main">All episodes of Foxes ever</Title>
      <Synopsis>More Foxes than you can handle</Synopsis>
```

```
      <Keyword>Foxes</Keyword>
      <Keyword>all</Keyword>
      <Genre type="main">Comedy</Genre>
    </BasicDescription>
    <MemberOf>crid://hbc.com/comedy/all</MemberOf>
  </GroupInformation>
</GroupInformationTable>
```

3. A mapping of cast members to unique identifiers. The identifiers can be used in other metadata instances making searching easier. These descriptions are held in the CastMemberInformationTable.
4. Critical reviews of items of content. These descriptions are held in the ProgramReviewTable.

5.3.3 Instance Description Metadata

Instance Description metadata is divided into four areas:

1. Descriptions of particular instances (locations) of content. These descriptions are held in the ProgramLocationTable. This metadata contains the scheduled time, but note that using this representation is *not* the preferred means of determining locations. The preferred means of determining locations is by resolving a CRID using the location resolution mechanism.

   ProgramLocationTable contains records (elements) that are derived from ProgramLocationType (this is a base type, it is not instantiated directly – see Specification Series: S-3 on Metadata):

```
<BroadcastEvent>
  <Program>crid://hbc.com/foxes/episode11</Program>
<BroadcastURL>dvb:// 1.4ee2.3f5/</BroadcastURL>
  <EventDescription>
    <PublishedTime>20010407T19.00+01:00</PublishedTime>
    <PublishedDuration>30</PublishedDuration>
    <Live>false</Live>
    <Repeat>true</Repeat>
    <FirstShowing>false</FirstShowing>
    <LastShowing>false</LastShowing>
    <Encrypted>false</Encrypted>
    <PPV>false</PPV>
  </EventDescription>
  <ServiceId>hbc100022311</ServiceId>
</BroadcastEvent>
```

   It is possible to also include a BasicDescription element within BroadcastEvent. One use of this element is where an actor appearing in the program has recently died, and the particular showing of the program is a tribute. This extra information becomes an attractor for the program. The synopsis of the program is altered to reflect the fact that the program features the deceased actor. It is more appropriate to change the synopsis for the instance, rather than the synopsis in the metadata attached to the CRID, as the "tribute" showing has a limited lifespan. Another use is where different instances have different technical attributes, such as aspect ratio or audio or video coding.

2. Descriptions of services within a system. These descriptions are held in the ServiceInformationTable. Each description is encapsulated by a ServiceInformation element, illustrated in the example:

```
<ServiceInformationTable>
  <ServiceInformation ServiceId="hbc100022311">
```

```
    <Name>HBC Channel 1</Name>
    <Owner>HBC</Owner>
  </ServiceInformation>
  <ServiceInformation ServiceId="kgt1042062318">
    <Name>KGT Channel 9</Name>
    <Owner>KGT</Owner>
  </ServiceInformation>
</ServiceInformationTable>
```

5.3.4 Consumer Metadata

Consumer metadata is divided into a number of areas:

1. Details of a user's preferences or profile. This information is delivered by the UserPreferences description scheme, which provides rich representations of the particular types of content preferred or requested by the user. These descriptions are closely correlated with media descriptions, and thus enable users to efficiently search, filter, select and consume desired content. In the following example, the user ("Robert") prefers news programs in English, when he is in Japan. The user also prefers comedy films reviewed and ranked by a particular film critic, as well as movies rated PG-13 by the MPAA (Motion Picture Association of America).

```
<UserPreferences>
    <UserIdentifier protected="true">
        <UserName xml:lang="en">Robert</UserName>
    </UserIdentifier>
    <UsagePreferences allowAutomaticUpdate="false">
        <FilteringAndSearchPreferences>
            <ClassificationPreferences preferenceValue="10">
                <Language>en</Language>
                <Genre href="urn:mpeg:GenreCS">
                    <Name>News</Name>
                </Genre>
            </ClassificationPreferences>
            <ClassificationPreferences preferenceValue="12">
                <Genre href="urn:mpeg:GenreCS">
                    <Name>Comedy</Name>
                </Genre>
                <MediaReview>
                    <Rating>
                        <RatingValue>7</RatingValue>
                        <RatingScheme best="10" worst="1"
                            style="higherBetter"/>
                    </Rating>
                    <Reviewer xsi:type="PersonType">
                        <Name>
                            <FamilyName>Ebert</FamilyName>
                            <GivenName>Roger</GivenName>
                        </Name>
                    </Reviewer>
                </MediaReview>
                <ParentalGuidance>
                    <ParentalRating
                        href="urn:mpeg:MPAAParentalRatingCS:PG-13">
                        <Name>PG-13</Name>
                    </ParentalRating>
                    <Country>us</Country>
                </ParentalGuidance>
            </ClassificationPreferences>
            <PreferenceCondition>
                <Place>
```

```
                    <Name xml:lang="en"><Name>Tokyo</Name>
                    <Country>jp</Country>
                </Place>
            </PreferenceCondition>
        </FilteringAndSearchPreferences>
    </UsagePreferences>
</UserPreferences>
```

2. Details of a user's "click data", i.e., an actual usage history of a user's actions. UsageHistory description scheme provides a list of the actions carried out by the user over an observation period. This information can subsequently be used by automatic analysis methods to generate user preferences. An extensive example can be found in Appendix A.

5.4 Documents related through the CRID

Parts of a TV-Anytime document are related through the CRID. Metadata may be distributed across many TV-Anytime documents, but it is always possible to relate appropriate pieces through CRIDs.

5.4.1 Grouping

Programs can belong to groups, and groups can belong to other groups. This relationship is reflected in the metadata, again by linking program descriptions with group descriptions using CRIDs.

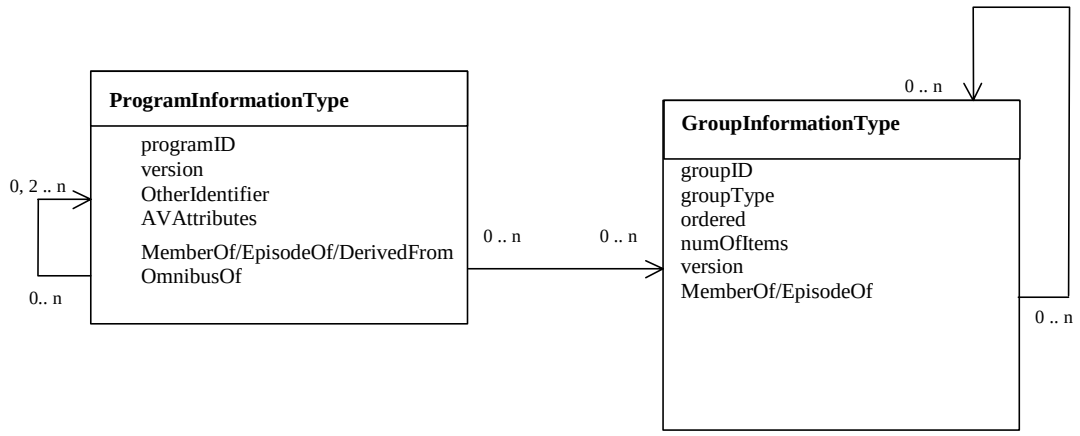

Figure 5-2 Program descriptions related to group descriptions through the CRID

ProgramInformation elements are related to GroupInformation elements through the memberOf or episodeOf elements, i.e., the memberOf element contains a group CRID e.g., Foxes Episode 11 is a member of the Foxes group, which is a group that aggregates all episodes of Foxes. This supports the feature where a viewer can say "I like this. What is it? Are there more programs like this?" By navigating up to the group the viewer may discover that the group is a member of another group and so forth. The higher one goes in the tree the more general the concepts become, i.e., moving from a specific episode of Foxes, to all episodes of Foxes, to all comedy shows, to all shows.

This upward pointing nature of group representation in the TV-Anytime metadata is the opposite of the content resolution process which is downward pointing (group CRIDs resolve into other CRIDs which resolve into locators).

5.5 TV-Anytime document structure

The following example illustrates the structure of a valid TV-Anytime document:

```
<TVAMain version=”…” lang=”en” publisher=”…” publicationTime=”…”>
  <CopyrightNotice>…</CopyrightNotice>
  <ContentDescription>
    <ProgramInformationTable>…</ProgramInformationTable>
    <GroupInformationTable>…</GroupInformationTable>
    <ProgramLocationTable>…</ProgramLocationTable>
    <ServiceInformationTable>…</ServiceInformationTable>
    <CastMemberInformationTable>…</CastMemberInformationTable>
    <ProgramReviewTable>…</ProgramReviewTable>
  </ContentDescription>
  <UserDescription>
    <UserPreferences>…</UserPreferences>
    <UsageHistory>…</UsageHistory>
  </UserDescription>
</TVAMain>
```

Many of the elements are optional, so the following examples are also valid documents:

```
<TVAMain version=”…” lang=”en” publisher=”…” publicationTime=”…”>
  <CopyrightNotice>…</CopyrightNotice>
  <ContentDescription>
    <ProgramInformationTable>…</ProgramInformationTable>
  </ContentDescription>
</TVAMain>
```

```
<TVAMain version=”…” lang=”en” publisher=”…” publicationTime=”…”>
  <CopyrightNotice>…</CopyrightNotice>
  <ContentDescription>
    <GroupInformationTable>…</GroupInformationTable>
  </ContentDescription>
</TVAMain>
```

```
<TVAMain version=”…” lang=”en” publisher=”…” publicationTime=”…”>
  <CopyrightNotice>…</CopyrightNotice>
  <UserDescription>
    <UserPreferences>…</UserPreferences>
    <UsageHistory>…</UsageHistory>
  </UserDescription>
</TVAMain>
```

5.6 Mandatory and optional elements

The TV-Anytime XML Schema contain many elements that are optional and some that are mandatory. The diagram shows the mandatory parts of ProgramInformation:

```
<ProgramInformationTable>
  <ProgramInformation ProgramId="crid://hbc.com/foxes/episode1">
    <BasicDescription>
      <Title type="main">
        The one where Fox jumps in the Potomac
      </Title>
      <Synopsis>
        Fox goes to Washington and jumps in the Potomac
```

```
      </Synopsis>
    </BasicDescription>
  </ProgramInformation>
</ProgramInformationTable>
```

The next chapter describes some cookbook examples how metadata and content referencing can work together in a system.

6. Cookbook examples and scenarios

This chapter describes the phases identified in a TV-Anytime System. It is followed by an example to give an overview of how a system might work. Further details and issues that arise from this example are identified in the final section. The example will cover both usage of both content referencing and metadata.

6.1 TV-Anytime dynamic phases

Phases in a TV-Anytime session are depicted in Figure 6-1. A more detailed explanation of these phases is covered by 'TV-Anytime R-2: System Description'.

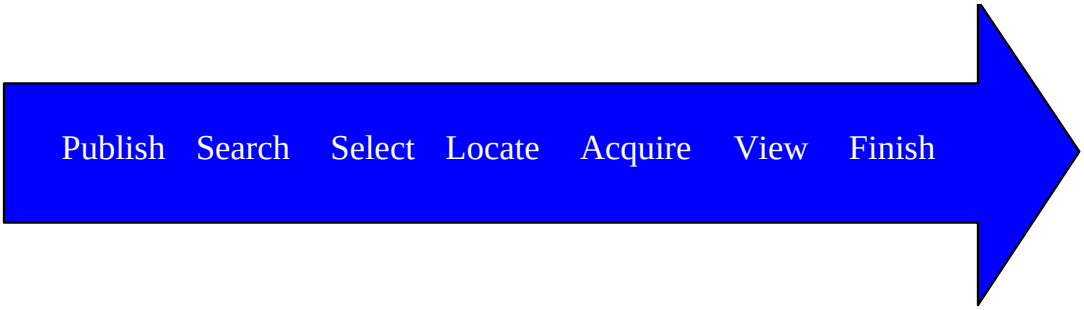

Figure 6-1 Phases in a TV-Anytime system

The next section presents an example that shows, per phase, the steps that are to be taken in a TV-Anytime system.

6.2 Example: Record every episode of this program series in the broadcast case

This example shows how the current TV-Anytime system may work using the Content Referencing specification (S-4) and the Metadata specification (S-3). The example is intended to give an overview of the system; more specific issues per phase will be covered later in this section.

Publish

A content service provider will publish a CRID that represents a program series, and CRIDs that represent the constituents of that program series. The same or different service provider will publish metadata that describes this series and its constituent episodes. The same or different service provider will publish location resolution data that describes where and when the constituent episodes of this series may be acquired. The series may be available from multiple content service providers.

In this example we will use a comedy show 'Fox' which has two episodes. The included XML snippets show an almost minimal way to describe this show and its episodes. Three metadata tables are needed to describe the relations for the Fox show. The GroupInformation table that holds information for all episodes of Fox and two ProgramInformation tables that contain information for the different episodes.

The link between the group and the episodes is made by the content referencing system: if the Group CRID "//hbc/foxes/all" is put to the resolution engine in the PDR, it will come back with both program CRIDs. The link between programs and the group is being made by the <memberOf> element in the ProgramInformation table.

```
<GroupInformation GroupId="crid://hbc.com/foxes/all" GroupType="show"
Ordered="true" NumberOfItems="2">
  <BasicDescription>
    <Title type="main">All episodes of Foxes ever</Title>
    <Synopsis Length="short">More Foxes than you can
handle</Synopsis>
  </BasicDescription>
  <MemberOf>crid://hbc.com/comedy/all</MemberOf>
</GroupInformation>
```

```
<ProgramInformation ProgramId="crid://hbc.com/foxes/episode1">
  <BasicDescription>
    <Title type="main">
      The one where Fox jumps in the Potomac
    </Title>
    <Synopsis Length="short">
      Fox goes to Washington and jumps in the Potomac
    </Synopsis>
  </BasicDescription>
  <MemberOf>crid://hbc.com/foxes/all</MemberOf>
</ProgramInformation>
```

```
<ProgramInformation ProgramId="crid://hbc.com/foxes/episode2">
  <BasicDescription>
    <Title type="main">
      The one where Fox drowns in the Lake of Geneva
    </Title>
    <Synopsis Length="short">
      Fox goes to Geneva and tries to climb the fountain
    </Synopsis>
  </BasicDescription>
  <MemberOf>crid://hbc.com/foxes/all</MemberOf>
</ProgramInformation>
```

To allow PDRs to build for, example, an EPG or to inform the user of the approximate schedule of an airing, InstanceMetadata can be used. This is useful, for example, when a user is interested in watching a program in a non-time shifted manner. The BroadcastEvent table in the instance metadata is used for that purpose. It is *NOT* there to signal to the PDR where and when a particular program really can be found: that is the job of content referencing and location resolution mechanism. As stated before, the metadata is used mainly for attraction purposes. An example XML snippet of a BroadcastEvent table is given below:

```
<BroadcastEvent>
 <Program>crid://hbc.com/foxes/episode1</Program>
 <BroadcastURL>dvb://1.4ee2.3f4/</BroadcastURL>
 <EventDescription>
  <EventID>4f5</EventID>
  <PublishedTime>2001-04-05T21:00:00.00+01:00</PublishedTime>
  <PublishedDuration>30</PublishedDuration>
 </EventDescription>
 <ServiceId>hbc100022311</ServiceId>
</BroadcastEvent>
```

Search

One example of a search is a user searching for the title of a series, e.g., “Foxes”, that he is interested in. The result of the search is a list of matching titles and associated identifiers (CRIDs). To refine his search further, the user must examine other metadata that can be

attached to the CRID. The user can refine his search further to identify the particular series he wants to acquire, e.g., “Foxes in the Wild”. The search may then be refined even further, e.g., by specifying PPV or free-to-air or quality.

Another example is that a user likes the program he is currently viewing and wants to see more programs like this one. First the system must find the CRID of the current program being viewed. If the program is played from disk then the system should have stored the identity of the program and associated metadata. If the program is “live” then the system must be able to find the CRID of the program on the current channel. Once the CRID has been found then the system must find the metadata associated with this CRID and interrogate it. In this example the program is a member of a series. The user reads the description of the series and decides to record the whole series.

Other search mechanisms, based on the UserPreferences metadata are also possible. The search intention can for example be captured in the UserPreference DS.

In this example the user searches for “Fox”. The PDR in this example examines the title and synopsis fields of the Group and Program information table and outputs as a result of his search three descriptions, one of the group, and two of the episodes. Other implementations could also search other metadata elements like keywords or genre. The user selects episode 2 and reads the synopsis. For this example we assume that after viewing info about this episode the user wants to record the whole series.

Select

For our example we assume that the PDR will offer the user the option to record the whole series. At this point to get the whole series the PDR examines the MemberOf element in the ProgramInformation table and sees that the episode is part of a show called ‘Fox’ with CRID “//hbc.com/foxes/all”. With this CRID available it will try to locate the actual episodes in the next phase.

At this point the usage history metadata table in the PDR could be updated, showing that he user has made a selection. An example XML snippet is below:

```
<UsageHistory id="usage-history-001" allowCollection="true">
  <UserIdentifier protected="true">
    <UserName xml:lang="en">John Doe</UserName>
  </UserIdentifier>
  <UserActionHistory id="useraction-history-001" protection="false">
    <ObservationPeriod>
      <TimePoint>2001-02-02T18:00-08:00</TimePoint>
      <Duration>PT96H</Duration>
    </ObservationPeriod>
    <ObservationPeriod>
      <TimePoint>2001-02-02T18:00-08:00</TimePoint>
      <Duration>PT6H</Duration>
    </ObservationPeriod>
    <UserActionList id="ua-list-001"
      numInstances="1" totalDuration="P2H30M">
      <ActionType                    href="urn:tva:TVAFUserActionCS
><Label>Record</Label></ActionType>
      <UserAction>
        <ActionTime>
           <ActionMediaTime>
            <MediaTimePoint>2001-02-02T19:00:00</MediaTimePoint>
            <MediaDuration>PT1H</MediaDuration>
           </ActionMediaTime>
        </ActionTime>

        <ProgramIdentifier organization="TVAF" type="CRID">
           crid://hbc.com/foxes/all
        </ProgramIdentifier>
</UserAction>
```

This usage history could also be used by the PDR to fill the user preference metadata tables. A more extensive example of usage history can be found in Appendix A.

As far as the user is concerned, the system will now autonomously make the content available at some point in the future.

Locate

Once the particular series has been chosen the series must be "resolved" to its constituent episodes. Given the CRID for the series the location resolution functional unit will return a list of CRIDs that refer to each episode. This relies on the fact that the location resolution data is made available to the box.

The resolution process continues until each of the episodes is then resolved to locations (channel/time/duration in the broadcast case). For each episode there may be several locations, e.g., repeats. These locations contain the same content as far as the service provider is concerned.

For our example, the show "Fox" has the following resolution tables associated with it:

```
<ContentReferencingTable>
  <!-- CRID resolution to other CRIDs -->
  <Result CRID="crid://hbc.com/foxes/all"
      status="resolved" complete="true" acquire="all">
    <CRIDResult>
      <Crid>crid://hbc.com/foxes/episode1</Crid>
      <Crid>crid://hbc.com/foxes/episode2</Crid>
    </CRIDResult>
  </Result>
  <!-- CRID resolution to locators -->
  <Result CRID="crid://hbc.com/foxes/episode1" status="resolved"
      complete="true" acquire="all">
    <LocationsResult>
      <Locator>dvb://1.4ee2.3f4;4f5@2001-04-
05T21:00:00.00+01:00/PT00H45M
      </Locator>
    </LocationsResult>
  </Result>
  <Result CRID="crid://hbc.com/foxes/episode2"
      status="cannot yet resolve" complete="true"
      acquire="all" reresolveDate = "2001-09-09T12:00:00.00+01.00">
  </Result>
</ContentReferencingTable>
```

In the XML instance it can be seen that the Group CRID has two CRIDs associated with it, those of episode 1 and 2 of "Fox". In the example a DVB locator is used for episode one, the PDR already knows when and where this episode can be found. Episode two is somewhere in the future at an unknown time, so if the PDR tries to resolve that it will know to try again after the 9th of September 2001.

Note that the syntax of the locator is not specified here. For purposes of illustration, a locator has been dreamt up by appending an existing DVB locator with an '@' and a string to express time and duration according to ISO standard 8601.

Acquire

The local storage management function will use any alternative locators to resolve recording conflicts. The chosen locator will then be used to tune to the specified channel at the specified time and record for the specified duration. To ensure that the content is recorded the system must monitor for changes in the location of the content. For example, the program may be moved to a different channel. This may involve re-resolution of the CRID.

In addition, to accurately record the desired content it may be necessary to take advantage of lower-level system features such as Program Delivery Control (PDC) or DVB event IDs. An

example would be where the showing of a program is delayed - if the original time and duration are followed the end of the program will not be recorded.

Verification that actually the program that was asked for has been recorded is not currently supported in TV-Anytime.

View

Once the episodes of the series have been acquired they are made available for viewing. As the viewer may want to view the associated metadata at the time of playback, the system should store the associated metadata at the time of selection or capture. If the metadata changes between selection and playback, it may be necessary to use version or timestamp information to present useful information to the user. For example, if one episode of a series advertised a particular guest actor as appearing, but did not take part, this may affect whether the user may wish to view the program.

To allow users to know what they actually have recorded on their PDR, at least a minimal set of metadata needs to be kept with the content. In our example that could be programInformation tables, allowing the user to see title and synopsis of programs he recorded.

Finishing

This may involve a user preference system storing information about the viewing of this series or episode. This information could then be used by an agent to determine the preferences of the user. An extensive example of usage history can be found in Annex A.

The following figure gives a graphic representation of this process.

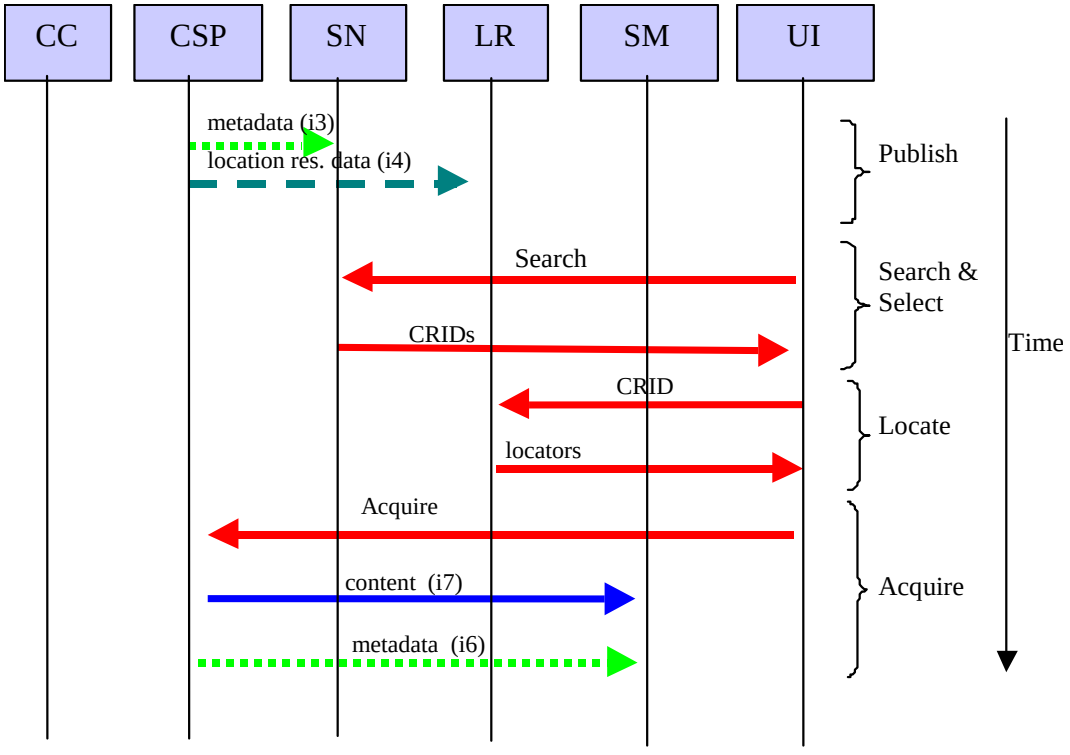

Figure 6-2 Dynamic behaviour of TV-Anytime system example

6.3 Issues per phase

This section gives some explicit implementation hints for less obvious issues in the different TV-Anytime phases. Not all phases are covered in this specification, since it focuses at the use of content referencing.

6.3.1 General System issues

To get an actual TV-Anytime system into the phases described in the previous sections some generic system issues need to be solved. These issues are out of the scope of TV-Anytime, but some of them are presented here to ease the implementer's life. Most issues are related to actual PDR implementations. The issues fit into a number of categories discussed below.

6.3.1.1 Set-up and service discovery

In the set-up phase of a PDR, e.g., when the user first installs a box in his home, a number of things need to be done to allow for it to find the TV-Anytime metadata and location resolution services. The way that this works is transport dependent and no complete descriptions for all transports are given, the analogue case and the digital DVB satellite case are discussed below.

Analogue environment

For content resolution to work in an analogue environment a mapping between a content reference ID and a physical channel frequency, date and time or duration needs to be made. This information can be carried via IP in the VBI, for example, or via a smart card or floppy disc. In the VBI case the box only needs a well know port number to do service discovery. After the location of the resolution tables and resolution authority records are known, download of those can commence. Metadata is probably too bulky to be carried in the VBI, so other means of getting that into the box need to be there, e.g., a telephone line.

For the analogue situation a preferred way of issuing locators would be, for example, **analog:cablenetworkXYZ/broadcaster/8am/1hour**. This would allow the broadcaster to use the same locators across multiple cable networks since frequency allocations will be different. For this to work the box needs to be able to make the mapping between channel name and physical channel frequency. This can be done during set-up by the user or, for example, in a Western-European PAL environment by looking at VBI information carrying Program Delivery Control for analogue VCRs. The same trick would also be useful in a digital environment with broadcasters being on a number of different media like satellite, cable etc.

Similarly for metadata, the box needs to be able to find out where metadata is carried. This could be done via the VBI, e.g., using teletext or PDC.

Digital DVB environment

In the DVB environment, operation is similar but for the actual locators that are put into the location resolution tables. In the DVB environment service information, programme IDs, event triggers and start-stop times could, for example, be used. To get the location resolution authority records, the box needs to know where to look in the transport stream.

One solution could be that there is a well-known service, e.g., 'TV-Anytime services' in the transport containing pointers to all data needed by the box, e.g., it would point to the location of location resolution authority records and actual location resolution tables.

Another possibility is that each broadcast service contains its own 'TV-Anytime services' entry pointing at the relevant tables.

In the DVB environment containers should be reserved, e.g., tables or sections that could carry the pointer to the TVA metadata. The current TVA specifications do not cater for this.

6.3.1.2 Transport and delivery of TV-Anytime data

The transport and delivery of TVA data requires the definition and specification of a set of technical features currently not covered by the TV-Anytime specification. These features, subject to a Call for Contributions, can be summarized as follows:

- *Identification and signaling*: an identification mechanism (e.g., a metadata location descriptor corresponding to a specific metadata format) is needed to associate specific resources to the transport of TVA data, and to signal that data being transported is, for example, TVA data. Signaling can also be used to inform the system about the presence of incoming TVA data

- *Location*: a mechanism (e.g., a resolving authority record or a metadata locator) that allows to point at the actual location of the data container from which location resolution data or metadata will be retrieved. The definition of a locator needs to take into account the transitory nature of the associated information.

It should allow identifying, signaling and locating TVA data carried over a variety of transport system (e.g., MPEG TS – over the PES, a data or object carousel, in metadata section, or over IP).

6.3.1.3 Updating resolution tables

Both the Resolving Authority Record (RAR) tables and the Resolution tables need to be kept up to date. The Resolving Authority Records contain information about the various resolution services available to the PDR device. The Resolution tables contain the mappings of CRIDs to other CRIDs or to locators. In the broadcast scenario, these tables must be pushed to the box, most likely using a broadcast carousel. Whole tables should be sent regularly to provide for new PDRs entering the system, but incremental updates are also useful, as they save bandwidth and also (probably) require less processing power at the client device when they are received.

Changes in the version field of the RAR (made by the location resolution provider) indicate to the client an update of all RARs for a given authority serviced by this provider. The expiry date of a RAR is an additional trigger for updates. The updating of location resolution tables is tied to the transport mechanism.

Below is an example of updating RARs where a resolution provider has several resolution services available in the same box. In the example, the broadcaster HBC has three channels on the multiplex (HBC1, HBC2 and HBC Gold, which are available on dvb://1.2eef.3f5, dvb://1.2eef.106 and dvb://1.2eef.3f5, respectively). A fourth channel is provided by another broadcaster who is also a resolution provider (broadcaster.co.jp). This channel is available at dvb://1.104.e5f.

The PDR has 4 RARs stored, three of which point to resolution services provided by HBC and another RAR which points to the resolution service of the other broadcaster.

	RAR A	**RAR B**	**RAR C**	**RAR D**
RAR fields				
Authority	hbc.com	creator.com	creator.com	creator.com
Resolution Provider	hbc.com	hbc.com	hbc.com	broacaster.co.jp
URL	dvb://1.2eef.3f5	dvb://1.2eef.106	dvb://1.2eef.3f5	dvb://1.104.e5f
Version	24	2	2	96

RAR A refers to CRIDs created by the broadcaster hbc.com who is also a resolution provider for hbc.com CRIDs. RAR B, RAR C and RAR D all refer to resolving CRIDs created by the creator.com CRID authority.

If the PDR receives a RAR which contains

Authority	creator.com
Resolution Provider	hbc.com
URL	dvb://1.2eef.3f6

Version	3

the PDR will discard all the RARs which have authority equal to creator.com and provider equal to hbc.com. In this example, the RAR above would cause RAR B and RAR C to be discarded and the new RAR to be stored in the PDR.

	RAR A	**RAR D**	**RAR E**	
RAR fields				
Authority	hbc.com	creator.com	creator.com	
Resolution Provider	hbc.com	broacaster.co.jp	hbc.com	
URL	dvb://1.2eef.3f5	dvb://1.104.e5f	dvb://1.2eef.3f6	
Version	24	96	3	

If the resolution provider wanted to update RAR B and keep RAR C as it is, they will need to transmit new versions of both RARs.

	RAR A	**RAR D**	**RAR E**	**RAR F**
RAR fields				
Authority	hbc.com	creator.com	creator.com	creator.com
Resolution Provider	hbc.com	broacaster.co.jp	hbc.com	hbc.com
URL	dvb://1.2eef.3f5	dvb://1.104.e5f	dvb://1.2eef.3f6	dvb://1.2eef.3f5
Version	24	96	3	3

6.3.1.4 Updating metadata

Currently there are no mechanisms defined that allow for update of part or all of the metadata.

6.3.2 Publishing phase

Re-run/repeat of content

A re-run is defined as content that is broadcast at different times to suit user convenience, sometime subsequent to its original broadcast. A repeat is generally regarded as old content. The content service provider may package content being re-shown within a short period of the original broadcast as a repeat, and leave the associated metadata untouched. If it is some months or years later, the content service provider may package it as a re-run and alter the associated metadata. The consumer may regard it as original viewing, as a re-run or as a repeat of the same content. Regarding the creation and publication of a CRID to reference the re-run/repeat, a number of scenarios can be envisaged:

1. The original CRID may be re-used, but with a new locator. Also, alternative space and time locations may be provided for the content after resolution. The PDR can take advantage of multiple location options to resolve recording conflicts. The use of the same CRID, if the content service provider always uses unique CRIDs, is also a way for the box to identify the item as having been previously consumed. If there is additional metadata available for this particular airing, instance metadata can be used.

2. The content service provider may issue a new CRID to refer to the re-run/repeat. From the PDRs perspective at least, the content is then regarded as different. The content service provider may package the programme with new metadata, for example, if a motion picture actor dies, then her films may be re-run, the fact that she has died being added to the metadata surrounding the movie.
3. A 3rd party may issue a group CRID to refer to all airings of an item across many different service providers. This has the advantage that the local storage management can use the group CRID to help solve recording conflicts. From the consumer's perspective, each occurrence is effectively a repeat even though they occur across service providers.

6.3.3 Search and select

Metadata from multiple providers

It is envisaged that multiple metadata providers will / can provide metadata for the same CRID. This information then could be linked via the CRID. However, there needs to be a metadata provider field, which is currently absent from the metadata specification.

Selection on basis of time/channel

"What's on at 8 o'clock tonight?"

The scenario depends on a few implementation issues (bullets 1 and 2 below) and/or how service providers will provide required metadata (bullets 3 and 4):

1. With a location resolution service that, when given a CRID, only provides locators, the box would have to resolve all CRIDs and search for all 8 o'clock entries.
2. If the box has access to the stored location resolution tables this is a straightforward query.
3. The service provider could issue a (group) CRID containing all the contents available at a given time. This is a limited solution, similar to a restricted EPG.
4. If the timing information is sent separately in the metadata stream (e.g., using instance metadata), there may be conflicts between the metadata and the location resolution data.

Note that content that is already recorded is available at any time.

Search & select based on metadata like cost

"I want to see a free version of the film 'Lizy, Queen of the desert'"

In the current metadata specification there is a Pay-Per-View (PPV) flag in the instance metadata indicating that there might be a charge to view the content.

Service provider will create distinct CRIDs and set the PPV flag in the instance metadata for the respective CRIDs appropriately. Thus there may be different CRIDs for the same program with different metadata. For efficient transmission it may be desirable to attach metadata to more than one CRID. The service provider could assign a group CRID for the set of programs.

1.

Essentially the same content has different CRIDs

"I want to get the 'Foxes' comedy show"

The same content, at least in the eyes of the consumer, can have different CRIDs, because different service providers might decide to do so. Three options arise to deal with this using metadata, third parties or unique identification, respectively:

1. A metadata search will return with multiple choices, with different CRIDs. The choice between them would depend on the available metadata. For example, the title field in the ProgramInformation table could be used to conduct such a search. Without a connection between the CRIDs of the content items grouping would have to be done in the box.

2. A metadata aggregator could generate a (group) CRID, which refers to all of the different CRIDs. This creates a single point reference for the content.

3. If the same content could be identified uniquely, the different offerings may be tied together in the box. Such a unique identifier could be carried in the OtherIdentifier field in the ProgramInformation table.

How to find a specific episode

"I want to see episode 15 of the original 'Foxes' series"

1. This is straightforward, if the index attribute in the programme description data contains the episode number.
2. The programme description data (e.g., title or synopsis) could contain the appropriate descriptive text for a textual search. Inconsistencies in phrases used may limit the use of a textual search.
3. If the (group) CRID returns an ordered list of CRIDs one could infer the episode number. This is a limited solution and is not currently part of the Content Referencing specification.

How to identify the latest episode of Foxes

"I want the latest episode of 'Foxes'"

This scenario can be implemented in the following ways:

1. A service provider generates a CRID, which points to the latest episode within a service.
2. A third-party generates a CRID, which points to the latest episode on all services.
3. Choosing a (group) CRID will lead to the capture of the next available episode.

Have I seen this content before?

"I don't want to record this if I've seen it before"

A box may store what the user has seen. If the box stores the CRID of the programme and all CRIDs were unique for all time, this would be sufficient. However, different service providers will use different CRIDs for the same content. Also service providers may issue a new CRID if the content has been changed only slightly or they want to promote the programme in a particular way. The system may need to store programme description data in order to fulfil this requirement. Alternatively, if a unique identifier is available in the OtherIdentifier field, this could be used for this purpose.

6.3.4 Location phase

"Make locator names unambiguous"

1. For example two satellites feed one box. In this scenario how does the system distinguish between say channel 5 from each satellite?

Or, phrased differently, what happens when the same service is on both physical inputs?

1. Box implementation issue. If the content on both feeds has the same CRIDs, the box can decide to listen to which ever feed based on some criteria (e.g., random "flip-a-coin criteria") or the PublicationType element in the user preferences DS can be used.
2. If CRIDs are different between the two feeds, which implies the content to be different (differences in quality, encoding type,). The user will be the one deciding which one to listen to.

"Re-resolution"

Currently there is no best practice defined for re-resolving locations. The only way to make sure that a PDR does not miss scheduling changes is to check back with the resolution tables every time they are updated. This drives the requirements for carriage of the data, i.e., frequency of re-transmission of location resolution data in the broadcast environment. Proper practice is to monitor the location resolution data, not the instance metadata.

6.3.5 Acquire phase

Acquisition of metadata with content and/or separate from content

Some metadata may be related to the actual timeline of the content, e.g., metadata that needs to show up at a certain point in the programme. Currently there is no way of synchronizing (meta) data with content in the TV-Anytime context.

Validation of content

On validation of the acquired content the following points are identified: -

- Trustworthiness of the resolving authority may be assumed
- It is impossible to attach the CRID used for resolving the content in all cases
- Other means of identification may be needed (e.g., V-ISAN, ISAN, Broadcaster own ID, …)
- However, it also is impossible to attach a globally registered ID in all cases

Validation is possible if all 'leaf'[5] CRIDs are attached to the content, which is easily achievable when only working in an environment involving a single service provider.

Rights management

Rights management topics such as Access Control, Content and Copy Protection need to be addressed in the acquisition phase once the Rights Management specification is developed.

Programme Delivery Control, signalling resolution updates

The resolution engine may inform the recording management unit of the latest updates in the delivery timing of the content (see Section 6.3.1.3). Alternatively the recording manager may poll the resolution engine. Recording management is an implementation issue and hence beyond the scope of this specification. However, service providers and box implementers are required to provide an accurate mechanism to update changes in the schedules similar to PDC.

It is suggested that more accurate timing may be achieved by using 'triggers' or other equivalent mechanisms in the transport stream e.g., DVB event ID. 'Triggers' can be part of locator syntax. It is noted that Triggers will be transport dependent, e.g., DVB, ATSC, and ARIB.

[5] A leaf CRID is a CRID which when resolved results in a location or locations

A.1 Example of Usage History DS

The following example highlights the usage history for the 'John Smith' user. During the observation period two episodes of the 'Fox' series were recorded and subsequently viewed. During the viewing of the 'Red Foxes' episode the user zoomed in twice. Finally the user previewed the 'Blue Foxes' episode.

```
<UsageHistory id="usage-history-001" allowCollection="true">
    <UserIdentifier protected="true">
        <UserName xml:lang="en">John Smith</UserName>
    </UserIdentifier>
    <UserActionHistory id="useraction-history-001"
        protection="false">
        <ObservationPeriod>
            <TimePoint>2001-02-02T18:00-08:00</TimePoint>
            <Duration>PT96H</Duration>
        </ObservationPeriod>
        <ObservationPeriod>
            <TimePoint>2001-02-02T18:00-08:00</TimePoint>
            <Duration>PT6H</Duration>
        </ObservationPeriod>
        <UserActionList id="ua-list-001"
            numInstances="2" totalDuration="P2H30M">
            <ActionType href="urn:tva:TVAFUserActionCS>
                <Name>Record</Name>
            </ActionType>
            <UserAction>
                <ActionTime>
                    <ActionMediaTime>
                        <MediaTimePoint>
                            2001-02-02T19:00:00
                        </MediaTimePoint>
                        <MediaDuration>PT1H</MediaDuration>
                    </ActionMediaTime>
                </ActionTime>
                <ProgramIdentifier organization="TVAF" type="CRID">
                    crid://broadcaster.com/RedFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
            </UserAction>
            <UserAction>
                <ActionTime>
                    <ActionMediaTime>
                        <MediaTimePoint>
                            2001-02-03T19:00:00
                        </MediaTimePoint>
                        <MediaDuration>PT1H</MediaDuration>
                    </ActionMediaTime>
                </ActionTime>
                <ProgramIdentifier organization="TVAF" type="CRID">
                    crid://broadcaster.com/GreyFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
        </UserActionList>
        <UserActionList id="ua-list-002"
            numInstances="25" totalDuration="P7H02M">
            <ActionType href="urn:tva:TVAFUserActionCS>
                <Name>View</Name>
            </ActionType>
            <UserAction>
                <ProgramIdentifier organization="TVAF" type="CRID">
```

```
                    crid://broadcaster.com/RedFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
            </UserAction>
            <UserAction>
                <ActionTime>
                    <ActionMediaTime>
                        <MediaTimePoint>
                            2001-02-04T20:30:00
                        </MediaTimePoint>
                        <MediaDuration>PT1M45S</MediaDuration>
                    </ActionMediaTime>
                </ActionTime>
                <ProgramIdentifier organization="TVAF" type="CRID">
                        crid://broadcaster.com/GreyFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
        </UserActionList>
        <UserActionList id="ual-003"
            numlnstances="2" totalDuration="PT10S">
            <ActionType href="urn:tva:TVAFUserActionCS >
                <Name>Zoom</Name></ActionType>
            <UserAction>
                <ProgramIdentifier organization="TVAF" type="CRID">
                        crid://broadcaster.com/RedFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
        </UserActionList>
        <UserActionList id="ual-004" numlnstances="1">
            <ActionType>
                <Name>Preview</Name>
            </ActionType>
            <UserAction>
                <ProgramIdentifier organization="TVAF" type="CRID">
                        crid://broadcaster.com/BlueFoxesCrid
                        ForThisEpisode
                </ProgramIdentifier>
        </UserActionList>
    </UserActionHistory>
</UsageHistory>
```