



## Automating Production of Cross Media Content for Multi-channel Distribution

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### DE4.7.1.2 Content Distribution toward mobiles, first update

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**Abstract:** This report provides an update on the state-of-the-art and the work performed by the Consortium partners based on the standards and technologies that need to be integrated for media distribution to mobile clients. These include the state-of-the-art in device profiling standards, transcoding for mobile distribution, and, DRM support for mobiles and their interoperability.

**Keyword List:** digital media distribution, profiling, transcoding, mobile, DRM, ringtones, proxies, MPEG-21, DIA algorithms, REL, optimisation, interoperability OMA MPEG-21, backoffice of AXMEDIS with OMA.

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## 1 Executive Summary and Report Scope (ALL)

The purpose of this deliverable is to provide an update to the DE4.7.1 “Distribution to Mobile” on the relevant state-of-the art and the RTD work carried out by the Partners in order to design and implement the required components for dynamic adaptation and provision of media to mobile clients to be integrated for the AXMEDIS Demonstrator. As such this report will update on the re-aligned transcoding plug-in and profiling based on MPEG-21 that will work integratively with the AXMEDIS JS Script Engine within the AXCP to deliver adaptive multimedia distribution to mobile clients.

In addition, a work has been performed in:

- styding the adaptation of licenses from MPEG-21 REL to ODLR OMA. (FUIFP)
- Production of OMA packages via AXMEDIS CP scripts (DSI)
- Automatisation of license adaptation from MPEG-21 REL to OMA (DSI)
- Exploitation of OMA model and distribution and trial of OMA distribution channel (DSI)

## 2 Analysis of Content Distribution Towards Mobiles (ILABS, UR)

Today’s telecommunication market is extremely interested in content-oriented services as a source for potential revenue. The AXMEDIS platform provides a comprehensive business perspective for both content providers and telecom service providers. A large variety of technologies and protocols are presently in use throughout the world, many of which are proprietary and do not adhere to any standard. Consequently, telecom operators encounter major challenges when attempting to deliver content-based value-added services. The AXMEDIS platform effectively addresses these challenges, by providing content owners with user-friendly tools in a familiar environment, and enables them to offer their content to a large number of users while ensuring content protection.

By increasing the number of accessible and standardised types of content, the AXMEDIS platform can assist operators and content providers in realising the following goals:

- Increase end user satisfaction;
- Increase content offering to a broad range of customers supporting most diffused type of device (by streamlining content delivery to mobile handsets);
- Open new business opportunities to content providers and telecom operators.

Content distribution for mobile devices is performed using a “**content push**” method upon end user request (referred to as the “end user” or “subscriber” as the underlying business model will be mainly centred on subscription mechanisms). In order to reach the desired content, the subscriber navigates through a set of menus (including the element referred to as “catalogue” that comprises more than simple menu choices). All formats supported by the AXMEDIS platform are stored in the AXMEDIS Platform, and supplied upon request. The most relevant and usable encodings will be identified and developed (or integrated and made accessible) within the AXMEDIS platform. The platform will be capable of accepting any custom codecs and automatically supporting newly added formats whenever the necessary codec plug-in will be available. To ensure content protection the DRM should be used to define the type of protection and licensing methods.

### 2.1 Overview of Content Distributions Towards Mobiles (ILABS)

A content that has been designed for fruition on a PC when presented onto a PDA/Mobile may undergo a set of changes. These changes are decided and performed at the Factory side of the Mobile distribution. The first, and probably the more apparent is that content is highly probable to be scaled down to a smaller

dimension, as even the simplest of all apparent changes occurring (that is converting from landscape to portrait or vice versa) implies a change in:

- areas sizes (to retain the same content) and
- location of some specific content.

Unless the PDA/Mobile is able to automatically flip the screen (that is presenting data in landscape rather than portrait) such a transformation has to be done prior to delivery. Now this is not the only point as passing from PCs to PDA/Mobile, the change in display size implies:

- Lower display area
- Lower computational power
- Lower image quality
- Smaller fonts
- Worse anti-aliasing
- Scroll-bars / page tabs
- Different content distribution

This latter point may sound strange, but given the fact that the most diffused browser for Windows CE / Windows Mobile equipped PDA/Mobiles does not support CSS files and formatted HTML page will lose most of what foreseen at content design and production time.

This, in some contexts, where content quality or publisher / distributor branding is highly related to content quality may be a major limiting factor that may lead to the voluntary production of device customized content production. Moreover at rendering time (either at server or client side) of a content has to be taken into account that passing from a single page to a set of pages, links between portions of the same page (anchors) are turned into links between pages (URLs), including the return to “top of page” as the way content is browsed changes from:

- Scrolling to
- Paging

The same applies vice-versa. This process if performed manually is long, time consuming and potentially error prone as it could lead to programming problems like “missing links”... while if performed automatically requires a quite complex environment.

In the Mobile Factory all this will be made possible thanks to the combination of the solution initially introduced in our editing environment with the procedures and tools of AXMEDIS. In more detail this will be achieved as follows thanks to sets of purposely-defined rules:

- Content component identification and description,
- Content composition,
- Content formatting,
- Content adaptation and eventually
- Content distribution.

The AXCP is the way that allows adapting AXMEDIS contents on the basis of users’ devices characteristics. Given a device profile, it is possible to have a rule that “reads” the profile, extracts some relevant features like colour capability, screen size, screen resolution, sound capability and so on, and depending on these features can modify the AXMEDIS content in order to better fit to the user’s device capabilities. Basic steps of the adaptation mechanism are:

- get one or more device profile(s)
- get one or more content(s)
- for each device profile, and for each content:
  - read device profile and extract some relevant features;
  - depending on device features, modify the content;
  - store the content locally

The adaptation phase implies the use of AXMEDIS Plugins for image, audio, multimedia, text and video adaptation. Also on demand adaptation is foreseen through Query on Demand AXMEDIS module. Later contents are distributed through AXMEDIS PnP Tool.

### 2.1.1 General Plug and Play Transcoding and Media Adaptation

The AXDMA Adaptation must provide for efficient multimedia transcoding, any format to any format (including audio e.g. ringtones, image, text) to suit the standard characteristics of users' device(s) for distribution on-demand to existing mobile devices and new generation of mobiles and PDAs.

The potential volume of downloads by mobile devices requires an efficient transcoding architecture, thus the transcoding must be kept as efficient as possible i.e. it must minimise the complexity in the adaptation process. The requirement for optimising quality, efficiency and complexity of the transcoding process for distribution to mobiles will be increasingly important for video distribution where it could be even more critical since the videos are typically large files and more complex to for transcoding.

In order to complete the subscriber's request and deliver the requested content to the mobile device the requested files should be available either in the distributor CMS or in its AXMEDIS database. Therefore, in the latter case it is necessary for the CMS to be able to generate the requested object automatically from one (or more) source-files exploiting its interconnection with local AXMEDIS database and all other framework tools necessary for the task completion.

The following scenario illustrates typical Transcoding requirements. One WAV file has been uploaded into the system. An end user may need a version of this file in a format suitable for use on their own device. Moreover to play this file as a sample it should be clipped (to 30 seconds, for example) and converted to the low-quality WMA similar format, while to sell this file it should be in high-quality WMA similar format. In order to be acquired and played by the end-user system it should be therefore fully converted into one of the device supported formats. Summing up, for sample playing it should be clipped (e.g. to 10 seconds, for example), or supplied in full length, depending on the subscriber requested operation (pre-view or purchase).

It is taken for granted that among available possible purchase modes there is the infinite repetition bound to a specific device. This latter has to be identified along with its user in an unequivocal manner (for example [[phone-no + SIM] + IMEI] where parenthesis represent the binding hierarchy) and modifiable under explicit request to service provider following a change in device (new system of the same or different model when possible) or change in SIM due to any valid reason (loss, subtraction, obsolescence...).

In this scenario, we see that even simple interfaces will require several different file format instances at least. In order to service additional interfaces and devices, the number of required files quickly increases. The content manager or content administrator cannot generate these files manually, but the system can easily produce all of them using only the source files and the appropriate codecs for the needed conversion processes.

## 2.2 Profiling (UR)

The AXMEDIS platform supports cross-channel distribution, including that involving Mobiles, Satellite, Internet and Kiosks, for distribution of content in both push and pull (on-demand) modes. Each of the distribution channels in AXMEDIS are required to perform any necessary structuring and resolution of various parameters representing the user's device characteristics and additional user's preferences. One of the most widespread problems faced by these distribution channels is the issue of compatibility, support of various formats, and interoperability between different devices. This problem is prevalent for almost all types of devices irrespective of manufacturer (e.g. even the same manufacturer may produce two incompatible phones; and the incompatibility problem just multiplies given that target devices in use can come from multiple manufacturers). Hence the AXMEDIS Distribution channels must enable dynamic access to, structuring, update, storage, and integration, by way of AXMEDIS Content Processing Engine (AXCP), of personal, device and delivery context profile element values. Personalisation requirements can be seen in practice to demand a capability for profiling management, coupled with a requirement for dynamic collection and evaluation of personal, default and closure values of profile elements depending on the profile element values availability - Profiling Resolution.

Imagine a scenario in which a user wishes to download a polyphonic ring tone to his/her device. They connect to the system to browse the available content, and potentially listen to the top-level menu. They select a service: Dedications, Fun Greetings, Icons, Pictures, Ringtones, Polyphonic Ringtones, etc and then a content catalogue. Most systems present a hierarchy of content, starting, for example, with the most popular types such as pop music, folk music, classical music, ethnic music, etc. User then selects a top-level category and may have to access a lower level or two, until they can finally select their choice content. Next they must specify the mobile device to which they are uploading or sending the content. If the operator's network supports more than one type of device (as is usually the case), then either the system must select the type of device, assume a default, or ask the user to select the device from a list. Without this vital piece of information re the target device or with incorrect information, all the effort of navigating through the menus and selecting content will be pointless. The AXMEDIS platform can empower this process by storing personalised information in the database, which can be automatically retrieved. The information could include the history of the user, his preferences, and interest groups, and many other properties, as is the case with Recommender Systems. Such information can be used to modify the menu flow in order to ensure that the user's navigation and product selection is more optimised. The platform can promote content to the users and/or suggest a narrow cross-section of content to accelerate navigation and enhance choice making based on the users' history and that of other users from the same interest groups.

The AXMEDIS-compliant media objects are to be distribute-able globally over heterogeneous networks and dispatch-able to various kinds of terminals. Moreover, the people who will ultimately consume and interact with the content can all have different behaviours and preferences. Consequently, digital items should be adapted to fit their particular usage environment. For example mobile devices typically have limited terminal capabilities compared to larger devices such as PCs. Most mobile phones cannot display video while they are able to play audio files in some specific format. In such context, one should only send audio information to the device. Such adaptations are to be performed on the server side before the content is dispatched to the device. Transformations aimed at economising in network bandwidth utilisation must be performed on the server side as well. Once content is received in a form that is supported by the mobile device, a user may wish to modify it according to their own preferences. This latter adaptation is to be performed directly on the mobile side since different users with different preferences may share the device or the same user may own several devices and be using different devices depending on their usage context such as location, content type etc. Following the same idea, the device should be able to adapt the content to the environment characteristics, which are variable by nature. The seventh part of ISO/IEC 21000 (MPEG-21) specifies tools for the adaptation of Digital Items. More specifically, it proposes a set of normalised tools describing the usage environment of a digital item to command adaptation tools. According to such precedence, AXMEDIS-compliant devices should support content adaptation conformant with a number of MPEG-21 usage environment tools.



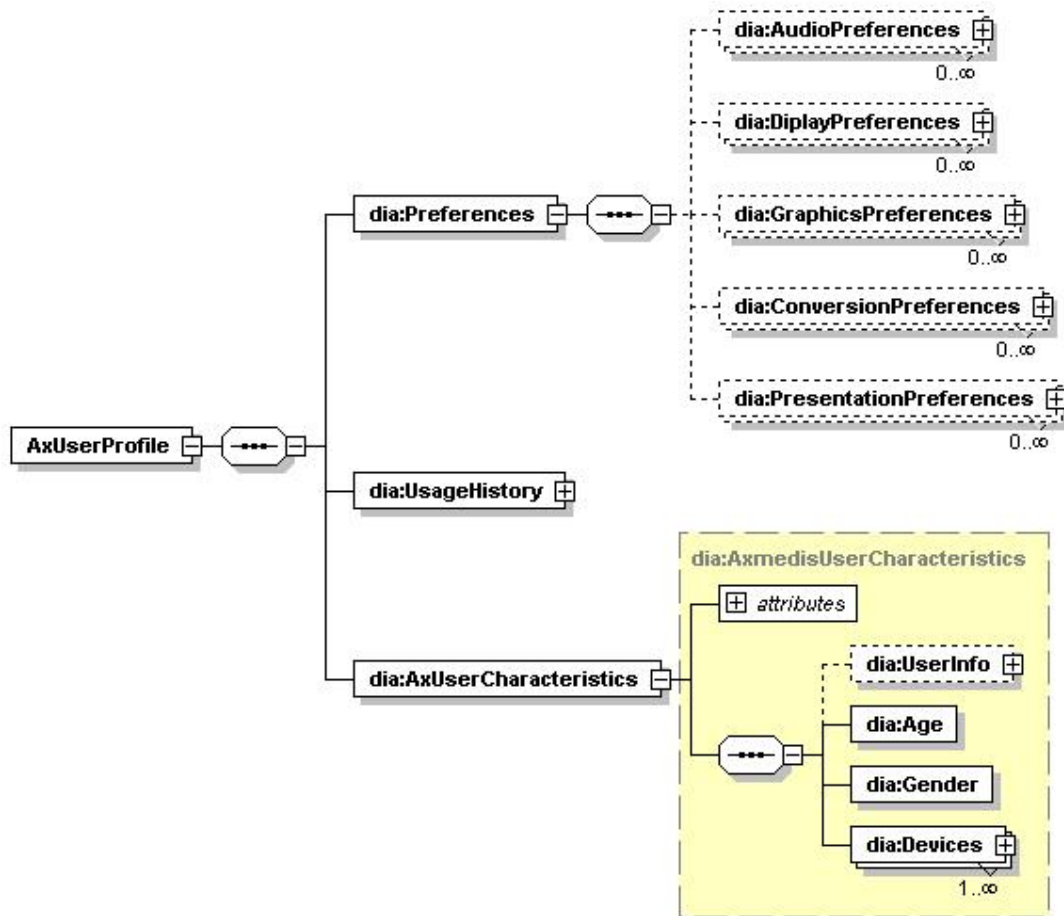
In order to fulfil these dynamic media adaptation requirements, we have envisaged the requirements for five different kinds of profiles elements derived from MPEG-21 DIA, which when deployed in combination enable enhanced personalised services. These profiles can be broadly categorised as follows:

1. **User Profiles:** This profile type represents the salient personal information about the user and his preferences, e.g. presentation preferences, auditory or visual impairment, etc.
2. **Device Profiles:** This profile represents the salient information about the user's device(s) including both hardware and software specific information, e.g. codecs, formats, I/O, etc.
3. **Network Profiles:** This profile represents the salient information about the distribution channel that the service provider must use for the delivery of the content, e.g. QoS related elements, bandwidth, error rate, security etc.
4. **Context Profiles:** This profile represents the salient delivery context information about the user and his usage environment, e.g. illumination characteristics, etc.
5. **Business User Profiles:** This profile is the Distributor's or prosumer's (producer-consumer) profile to support B2B media transaction scenarios, e.g. licenses acquired, etc.

The elements for Context Profile are covered in the Users Profile and Network Profile, while the Business User Profile can be seen as subsume-able within the User Profile in the generalised sense of the User which subsumes all types of User including users who are both producers and consumers (prosumers) of digital media as is increasingly the case i.e. User Profiles can be extended to include the twin profile roles (procurer and distributor) required to support the global prosumer, and thus the B2B, e-media market.

### 2.2.1 AxUserProfile

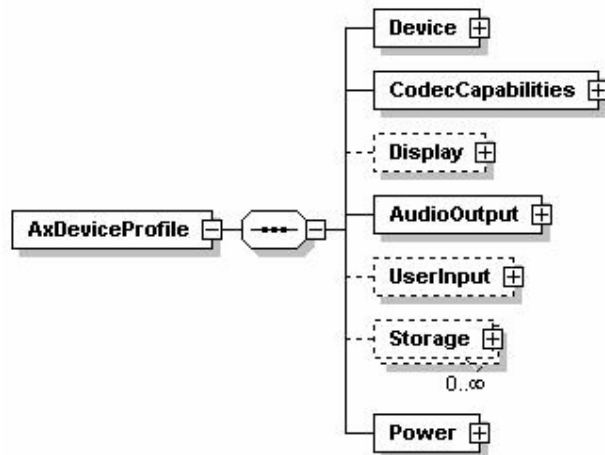
The users profile captures and stores information related to the users, the usage environment and the user preferences. This profile type is managed at the personalisation server end and includes at least minimal details about the user to identify his personal preferences in respect of the services being offered.



**Figure 2.1: Schema for AXMEDIS User Profile**

## 2.2.2 AxDeviceProfile

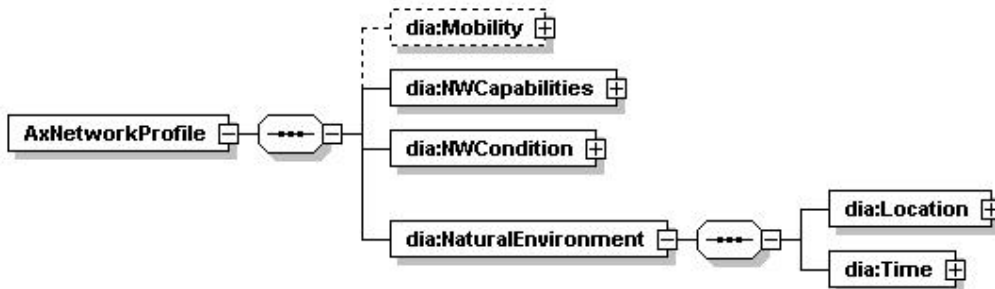
This device profile type captures information related to user's devices, that the service provider must take into account in delivering the contents. Generally the minimal set required comprises those that affect the proper utilisation of the contents on the device e.g. screen resolution for images. This profile type comprises the most vital information for the content providers to transcode the content to match the content to device characteristics to enhance the usage of the content.



**Figure 2.2: Schema for AXMEDIS Device Profile**

### 2.2.3 AxNetworkProfile

The Network Profile type captures bandwidth utilisation and QoS related information for the carrier to use to optimize delivery of the content to the user's device. It is necessary for the distributors to know various characteristics of the Network so as to attempt to provide the promised QoS. The information contained in this profile can also be used for transcoding of the contents to better utilise both network and device capabilities.



**Figure 2.3: Schema for AXMEDIS Network Profile**

## 2.3 Scripts Examples for Transcoding Content for Mobiles (ILABS, DSI)

### 2.3.1 AXCP Rule for Resizing Images

The following AXCP rule is used to resize set of images to match the screen size of the PDA/Mobile Device.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="Rule_AXMEDIS.xsd">
  <Header>
    <Rule_Name>ely2</Rule_Name>
    <AXRID>axcprule:00d0eea1-16af-49bd-974b-5082513a802f</AXRID>
    <Rule_Version>
```

```

</Rule_Version>
<Rule_Type>AXCP</Rule_Type>
<Software_Name>
</Software_Name>
<Version_of_software>
</Version_of_software>
<Date_of_production>2006-04-10</Date_of_production>
<Author>
</Author>
<Affiliation>
</Affiliation>
<URL>
</URL>
<Comment>
</Comment>
<Last_Modifications>2006-07-27</Last_Modifications>
<Terminal_ID>
</Terminal_ID>
<Cost>
</Cost>
<Work_Item_ID>
</Work_Item_ID>
</Header>
<Schedule>
  <Run>
    <Date>2006-04-10</Date>
    <Time>12:30:35</Time>
    <Periodicity Unit="Day">0</Periodicity>
    <Expiration_Date>2006-04-10</Expiration_Date>
    <Expiration_Time>12:30:35</Expiration_Time>
  </Run>
  <Status>Inactive</Status>
</Schedule>
<Definition>
  <AXCP_Rule>
    <Arguments>
      <Parameter Name="PathToObjects" Type="String">E:\AXMEDIS\temp\source</Parameter>
      <Parameter Name="objs" Type="String">Blood Frenzy.axm;</Parameter>
      <Parameter Name="ScreenW" Type="Integer">101</Parameter>
      <Parameter Name="ScreenH" Type="Integer">54</Parameter>
      <Parameter Name="outputPath" Type="String">E:\AXMEDIS\temp\result</Parameter>
    </Arguments>
    <Rule_Body>
      <JS_Script name="JScript(8)"><![CDATA[function test()
{
  var AXMEDISobjs = objs.split(";");
  print("AXMEDISobjs.length="+AXMEDISobjs.length);
  for (index=0;index<AXMEDISobjs.length-1;index++)
  {

```

```

print("AXMEDISobjs["+index+"]="+AXMEDISobjs[index]);
var newObj = new AXMEDISObject(PathToObjects+AXMEDISobjs[index]);
var resources = newObj.getContent();
print("resources.length="+resources.length);

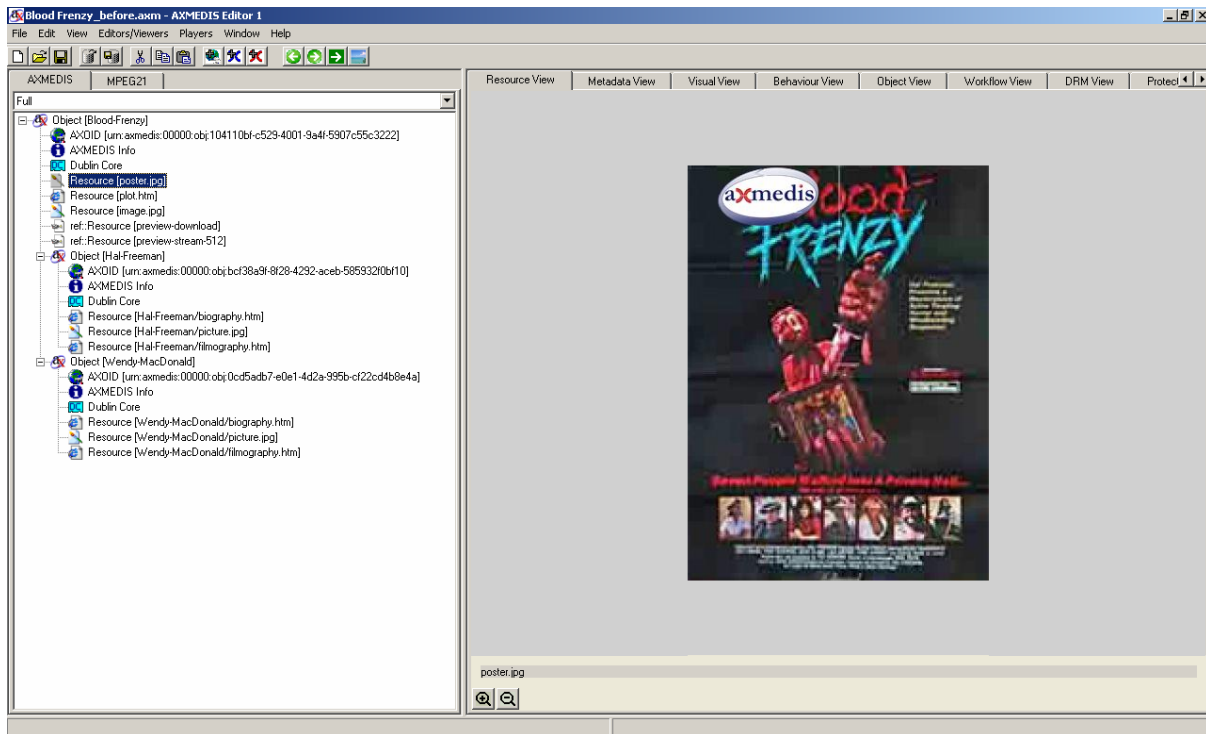
var h = new Array(1);
var w = new Array(1);
h[0]=0;
w[0]=0;
for (i=0;i<resources.length;i++)
{
    var aRes = resources[i];
    if (aRes.mimeType!=null)
    {
        var val = aRes.mimeType.search("image");
        (val==0)
        {
            ImageProcessing.GetInfo(aRes,h,w);
            print("Original resource size is "+h+"x"+w);
            print("Resizing the resource at "+ScreenW+"x"+ScreenH);
            ImageProcessing.Resize(aRes,ScreenH,ScreenW,false,aRes);

            ImageProcessing.GetInfo(aRes,h,w);
            var ipath = outputPath+"res"+i+aRes.ref;
            print(ipath);
            aRes.save(ipath);
        }
    }
}
print("Storing Object on disk");
var dc = newObj.getDublinCore();
var title = dc.getDCElementValue("title");
print (title);
newObj.save(outputPath+title+".axm");
}
return true;
}

//Entry point of the script();]]></JS_Script>
</Rule_Body>
<Dependencies>
<Dependency>
<Plug_In_name>ImageProcessing</Plug_In_name>
<Version>1.001</Version>
</Dependency>
</Dependencies>
</AXCP_Rule>
</Definition>
</Rule>

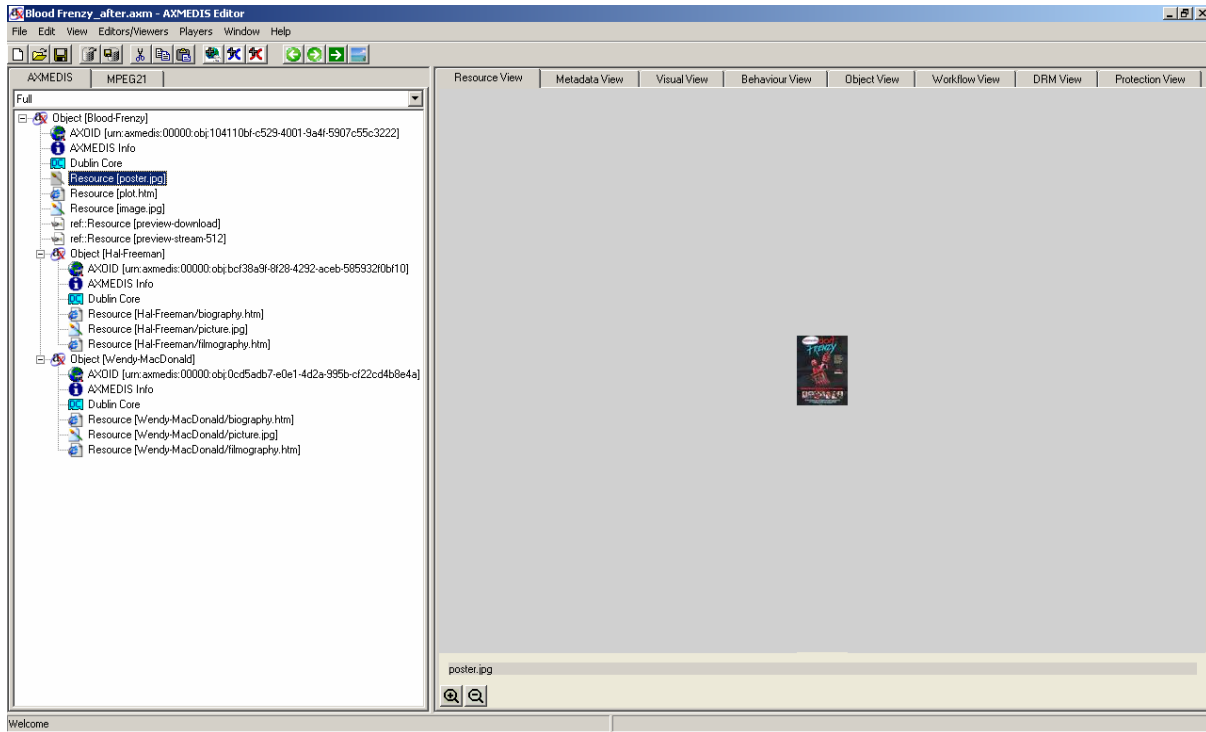
```

Consider the following screenshot for an AXMEDIS Object containing an image:



**Figure 2.4 : AXMEDIS Object Showing the Original Image**

After the execution of the above rule, the image in this object will be reduced to the size specified as shown in the following screenshot:



**Figure 2.5 : AXMEDIS Object Showing the Resized Image**

### 2.3.2 AXCP Rule for converting an Image from Colour to Black and White

The following AXCP rule is used to convert an image from Colour to Black and White. This rule is used for transcoding the image to be distribution on old fashion monochrome display PDA/Mobile Devices.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="Rule_AXMEDIS.xsd">
  <Header>
    <Rule_Name>ImageToBN</Rule_Name>
    <AXRID>axcprule:3c62ca39-dc96-44ab-8ae1-40c08c82c54a</AXRID>
    <Rule_Version></Rule_Version>
    <Rule_Type>AXCP</Rule_Type>
    <Software_Name></Software_Name>
    <Version_of_software></Version_of_software>
    <Date_of_production>2006-04-13</Date_of_production>
    <Author></Author>
    <Affiliation></Affiliation>
    <URL></URL>
    <Comment>get a colour image and convert it to B/N image</Comment>
    <Last_Modifications>2006-09-07</Last_Modifications>
    <Terminal_ID></Terminal_ID>
    <Cost></Cost>
    <Work_Item_ID></Work_Item_ID>
```

```

</Header>
<Schedule>
  <Run>
    <Date>2006-04-13</Date>
    <Time>14:56:10</Time>
    <Periodicity Unit="Day">0</Periodicity>
    <Expiration_Date>2006-04-13</Expiration_Date>
    <Expiration_Time>14:56:10</Expiration_Time>
  </Run>
  <Status>Inactive</Status>
</Schedule>
<Definition>
  <AXCP_Rule>
    <Arguments>
      <Parameter Name="ImageToProcess" Type="String">E:\titty.jpg</Parameter>

    </Arguments>
    <Rule_Body>
      <JS_Script name="JScript(4)"><![CDATA[function test()
{
  var h = new Array(1);
  var w = new Array(1);
  h[0]=0;
  w[0]=0;
  var aRes = new AxResource();
  aRes.load(ImageToProcess);

  print("Original resource size is "+h+"x"+w);
  ImageProcessing.Monochrome(aRes,aRes);
  var ipath = ImageToProcess.substring(0, ImageToProcess.indexOf("."));
  aRes.save(ipath+"BN");

  return true;
}

//Entry point of the script();]]>
    </JS_Script>
  </Rule_Body>
  <Dependencies>
    <Dependency>
      <Plug_In_name>ImageProcessing</Plug_In_name>
      <Version>1.001</Version>
    </Dependency>
    <Dependency>
      <Plug_In_name>AudioAdaptation</Plug_In_name>
      <Version>1.001</Version>
    </Dependency>
  </Dependencies>
</AXCP_Rule>

```



</Definition>

</Rule>

Consider the following coloured image. In order to distribute this image to a mobile device having a monochrome display, the above rule will be applied.



**Figure 2.6 : The Original Coloured Image.**

The output produce by the rule is as shown in the following of the image:



**Figure 2.7: The Image Converted to Black and White**

### 2.3.3 AXCP Rule for converting IMS packages into AXMEDIS Objects

The following AXCP rule is used to convert an IMS packages into AXMEDIS Objects.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="Rule_AXMEDIS.xsd">
  <Header>
    <Rule_Name>Upload_test</Rule_Name>
    <AXRID>axcprule:e8caaae1-1bc9-4699-9184-bb9a1918ffe9</AXRID>
    <Rule_Version></Rule_Version>
    <Rule_Type>AXCP</Rule_Type>
    <Software_Name></Software_Name>
    <Version_of_software></Version_of_software>
    <Date_of_production>2006-09-11</Date_of_production>
    <Author></Author>
    <Affiliation></Affiliation>
    <URL></URL>
```

<Comment>A script for contents creation that: takes a starting folder inside this folder there are some subfolders, each one has inside the content of an ims content package: an imsmanifest.xml + all its resource files for each folder inside the main folder, create a new AXMEDIS object having as its resources all the files inside the folder; get some information from imsmanifest and insert into DC; save on disk the newly created object.: since importing an html page with images inside with relative path does not work properly, a workaround has been used to modify html file.: since loading a file into a resource, the resource loses the extension, a workaround has been used to add file extension to contentid property of the resource.</Comment>

```
<Last_Modifications>2006-09-20</Last_Modifications>
<Terminal_ID></Terminal_ID>
<Cost></Cost>
<Work_Item_ID></Work_Item_ID>
</Header>
<Schedule>
  <Run>
    <Date>2006-09-11</Date>
    <Time>16:37:20</Time>
    <Periodicity Unit="Day">0</Periodicity>
    <Expiration_Date>2006-09-11</Expiration_Date>
    <Expiration_Time>16:37:20</Expiration_Time>
  </Run>
  <Status>Inactive</Status>
</Schedule>
<Definition>
  <AXCP_Rule>
    <Arguments>
      <Parameter Name="CurrentLanguage" Type="String">en-US</Parameter>
      <Parameter Name="startfolder" Type="String">C:\Documents and
Settings\ElisabettaP\Desktop\axcont_ArtistEN\</Parameter>
      <Parameter Name="default_image_path" Type="String">C:\default_img.jpg</Parameter>
      <Parameter Name="destinationfolder" Type="String">c:\contents_ax\v2</Parameter>
    </Arguments>
    <Rule_Body>
      <JS_Script name="JScript(1)"><![CDATA[// Extract manifest title and put in into
DCsetTitle(titleItem,obj)
{
for (var i=0; i<titleItem.childElements.length; i++)
{
var item = titleItem.childElements[i];
if (item.name=="langstring")
{
var dc = obj.getDublinCore();
if (item.text!=null && item.text!="")
{
dc.addDCElement("title",item.text);
titleOfCurrentContent = item.text;
//print ("TITLE is "+item.text);
}
}
}
}
```

```

    }
  }
}

// Extract manifest title and put in into DCsetDescription(descrItem,obj)
{
  for (var i=0; i<descrItem.childElements.length; i++)
  {
    var item = descrItem.childElements[i];
    if (item.name=="langstring")
    {
      var dc = obj.getDublinCore();
      if (item.text!=null && item.text!="")
      {
        dc.addDCElement("description",item.text);
        //print ("DESCRIPTION is "+item.text);
      }
    }
  }
}

// Extract manifest title and put in into DCsetCoverage(covItem,obj)
{
  for (var i=0; i<covItem.childElements.length; i++)
  {
    var item = covItem.childElements[i];
    if (item.name=="langstring")
    {
      var dc = obj.getDublinCore();
      if (item.text!=null && item.text!="")
      {
        dc.addDCElement("coverage",item.text);
        //print ("DESCRIPTION is "+item.text);
      }
    }
  }
}

// Set languagesetLanguage(obj)
{
  var dc = obj.getDublinCore();
  dc.addDCElement("language",CurrentLanguage);
}

// browse metadatabrowseMetadata(startNode, indent,obj)
{
  for (var i=0; i<startNode.childElements.length; i++)
  {
    var item = startNode.childElements[i];

```

```

        //print(indent + item.type + " "+item.name );
        if (item.name == "title")
        {
            setTitle(item,obj);
        }
        else if (item.name == "description")
        {
            setDescription(item,obj);
        }
        else if (item.name == "coverage")
        {
            setCoverage(item,obj);
        }
        if (startNode.name!="general")
        {
            browseMetadata(item, indent + " ",obj);
        }
    }
}

// read manifestparseManifest(xmlfile,obj)
{
    var strXML = readFromFile(xmlfile);
    var xmlDoc = new REXML(strXML);

    for (var i=0; i<xmlDoc.rootElement.childElements.length; i++)
    {
        var item = xmlDoc.rootElement.childElements[i];
        //print("Child element of type " + item.type + " "+item.name );
        if (item.name == "metadata")
            browseMetadata(item, " ", obj);
    }
    setLanguage(obj);
}

// Workaround for bad import of resources; flatten image path
// NOW it flattens only first image, TODO: flatten all images sourcesflattenImagesIn(aFile,axobj)
{
    var fileContent = readFromFile(aFile);
    var index = fileContent.indexOf("src=\"./");
    var firstpiece = "";
    var sndpiece = "";

    if (index >0)
    {
        // flatten image path
        index = index + "src=\"".length;
        firstpiece = fileContent.substring(0, index );
        sndpiece = fileContent.substring(index+5,fileContent.length );
    }
}

```

```

    var end  = sndpiece.substring(sndpiece.indexOf("\""), sndpiece.length);
    var ref  = sndpiece.substring(0,sndpiece.indexOf("\""));
    ref     = ref.substring(ref.lastIndexOf("/") + 1,ref.length);
    print ("-- ref="+ref);
    var result = firstpiece+ref +end;
    removeFile(aFile);
    writeToFile(aFile, result);
}
else
{
    // put default image filename
    index = fileContent.indexOf("src=\".");
    print("NO IMAGE index="+index);
    firstpiece = fileContent.substring(0, index + "src=\"".length);
    sndpiece  = fileContent.substring(index+5,fileContent.length );
    //print ("firstpiece="+firstpiece);
    //print("sndpiece="+sndpiece);

    var end  = sndpiece.substring(sndpiece.indexOf("\""), sndpiece.length);
    var ref  =
default_image_path.substring(default_image_path.lastIndexOf("\\")+1,default_image_path.length);

    //print ("-- ref="+ref);
    var result = firstpiece +ref +end;
    //print("result="+result);

    removeFile(aFile);
    writeToFile(aFile, result);

    // add default image as resource to the AXMEDIS object
    var res = new AxResource();
    res.load(default_image_path);
    res.contentID = res.contentID+mimeTypeToExt(res.mimeType);
    axobj.addContent( res );
}
}

// Get recursively all files in a folder and its subfolders, adding them to axobj and
reosourcesbrowseFolders(axobj, folder, indent)
{
    //print( indent + "folder =" + folder );
    var f = getFirstFile( folder );

    while(f!=null)
    {
        //print(indent + f);
        // add f as resource
        var res = new AxResource();
        // workaround for bad images import

```

```

    if (f.indexOf(".htm")!=-1)
    {
        flattenImagesIn(f,axobj);
    }
    else if (f.indexOf("imsmanifest.xml")!=-1)
    {
        print ("Found manifest file");
        parseManifest(f,axobj) ;
    }
    res.load(f);
    res.contentID = res.contentID+mimeTypeToExt(res.mimeType);
    axobj.addContent( res );
    f = getNextFile();
}
var l = listDir(folder); //It provides the list of folders
for (i in l)
{
    browseFolders(axobj, l[i], indent + " ");
}
}
test()
{
    var indexpage = "<html><head><title>Index of
contents</title></head><body><h1>Contents</h1><ul>";

    var l = listDir(startfolder); //It provides the list of folders

    for (i in l)
    {
        var aContentDir = l[i];
        // create new empty AXMEDIS object
        var axobj = new AXMEDISObject();
        var contid = aContentDir.substring( aContentDir.lastIndexOf("\\")+1, aContentDir.length);
        print("contid = "+contid);
        // add resources
        browseFolders(axobj, aContentDir, " ");
        indexpage += "<li><a href=\""+ contid + ".axm\" title=\""+titleOfCurrentContent
+"\">"+titleOfCurrentContent+"</a></li>";
        var savepath = destinationfolder + contid + ".axm";
        print(" -> saved "+ savepath);
        axobj.save(savepath);
        delete(axobj);
    }
    indexpage += "</ul></body></html>";
    writeToFile(destinationfolder +"index.html", indexpage);

    return true;
}
titleOfCurrentContent = "";();]]>

```



```

</JS_Script>
<JS_Script name="JScript(2)">

    <![CDATA[//////// JSXML XML Tools          //////////
//////// Ver 1.2 Jun 18 2001          //////////
//////// Copyright 2000 Peter Tracey //////////
//////// http://jsxml.homestead.com/  //////////
////
////:
////
////
//// Regular Expression-based XML parser
////
////
//// Iterates through the tree structure without recursion
////
////
//// Loads xml into a linear structure and provides
////for adding and removing elements
////setting attributes, generates XML
////
////functions:
////
////
//// Takes string of attributes and attribute name
//// Returns attribute value
////
////_Remove
//// Removes element in array
////
////_Add
//// Adds element to array
////
////
//// Repeats string specified number of times
////
//////////REXML(XML) {
.XML = XML;
.rootElement = null;
.parse = REXML_parse;
(this.XML && this.XML != "") this.parse();
}
REXML_parse() {
    reTag = new RegExp("<([^\>/ ]*)([^\>]*)>", "g"); // matches that tag name $1 and attribute
string $2
    reTagText = new RegExp("<([^\>/ ]*)([^\>]*)>([^\<]*)", "g"); // matches tag name $1,
attribute string $2, and text $3
    strType = "";
    strTag = "";

```



```

    strText = "";
    strAttributes = "";
    strOpen = "";
    strClose = "";
    iElements = 0;
    xmleLastElement = null;
    (this.XML.length == 0) return;
    arrElementsUnparsed = this.XML.match(reTag);
    arrElementsUnparsedText = this.XML.match(reTagText);
    i=0;
    (arrElementsUnparsed[0].replace(reTag, "$1") == "?xml") i++;
    (; i<arrElementsUnparsed.length; i++) {
        = arrElementsUnparsed[i].replace(reTag, "$1");
        = arrElementsUnparsed[i].replace(reTag, "$2");
        = arrElementsUnparsedText[i].replace(reTagText, "$3").replace(/[\r\n\t ]+/g, " "); //
remove white space
        = "";
        (strTag.indexOf("![CDATA[") == 0) {
            = "<![CDATA[";
            = "";
            = "cdata";
        } else if (strTag.indexOf("!--") == 0) {
            = "<!--";
            = "-->";
            = "comment";
        } else if (strTag.indexOf("?") == 0) {
            = "<?";
            = "?>";
            = "pi";
        } else strType = "element";
        (strClose != "") {
            = "";
            (arrElementsUnparsedText[i].indexOf(strClose) > -1) strText =
arrElementsUnparsedText[i];
            {
                (; i<arrElementsUnparsed.length &&
arrElementsUnparsedText[i].indexOf(strClose) == -1; i++) {
                    += arrElementsUnparsedText[i];
                }
                += arrElementsUnparsedText[i];
            }
            (strText.substring(strOpen.length, strText.indexOf(strClose)) != "") {
                .childElements[xmleLastElement.childElements.length] = new
REXML_XMLElement(strType, "", "", xmleLastElement, strText.substring(strOpen.length,
strText.indexOf(strClose)));
                (strType == "cdata") xmleLastElement.text +=
strText.substring(strOpen.length, strText.indexOf(strClose));
            }
            (strText.indexOf(strClose)+ strClose.length < strText.length) {

```

```

        .childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText.substring(strText.indexOf(strClose)+
strClose.length, strText.length));
        (strType == "cdata") xmleLastElement.text +=
strText.substring(strText.indexOf(strClose)+ strClose.length, strText.length);
    }
    ;
}
(strText.replace(/ */, "") == "") strText = "";
(arrElementsUnparsed[i].substring(1,2) != "/") {
    (iElements == 0) {
        = this.rootElement = new REXML_XML_Element(strType,
strTag, strAttributes, null, strText);
        ++;
        (strText != "")
xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText);
    } else if
(arrElementsUnparsed[i].substring(arrElementsUnparsed[i].length-
2, arrElementsUnparsed[i].length-1) != "/") {
        =
xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element(strType, strTag, strAttributes, xmleLastElement, "");
        ++;
        (strText != "") {
            .text += strText;
            .childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText);
        }
    } else {
        .childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element(strType, strTag, strAttributes, xmleLastElement, strText);
        (strText != "")
xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText);
    }
} else {
    = xmleLastElement.parentElement;
    -;
    (xmleLastElement && strText != "") {
        .text += strText;
        .childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText);
    }
}
}
}
REXML_XML_Element(strType, strName, strAttributes, xmlParent, strText) {
    .type = strType;

```

```

.name = strName;
.attributeString = strAttributes;
.attributes = null;
.childElements = new Array();
.parentElement = xmlParent;
.text = strText; // text of element
.getText = REXML_XML_Element_getText; // text of element and child elements
.childElement = REXML_XML_Element_childElement;
.attribute = REXML_XML_Element_attribute;
}
REXML_XML_Element_getText() {
    (this.type == "text" || this.type == "cdata") {
        this.text;
    } else if (this.childElements.length) {
        L = "";
        (var i=0; i<this.childElements.length; i++) {
            += this.childElements[i].getText();
        }
        L;
    } else return "";
}

REXML_XML_Element_childElement(strElementName) {
    (var i=0; i<this.childElements.length; i++) if (this.childElements[i].name ==
strElementName) return this.childElements[i];
    null;
}
REXML_XML_Element_attribute(strAttributeName) {
    (!this.attributes) {
        reAttributes = new RegExp(" ([^= ]*)=", "g"); // matches attributes
        (this.attributeString.match(reAttributes) &&
this.attributeString.match(reAttributes).length) {
            arrAttributes = this.attributeString.match(reAttributes);
            (!arrAttributes.length) arrAttributes = null;
            for (var j=0; j<arrAttributes.length; j++) {
                [j] = new Array(
                    (arrAttributes[j]+"").replace(/[/= ]/g, ""),
                    (this.attributeString, (arrAttributes[j]+"").replace(/[/=
]/g, ""))
                );
            }
            .attributes = arrAttributes;
        }
    }
    (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] ==
strAttributeName) return this.attributes[i][1];
    "";
}
}JSXMLBuilder() {
.XML = "";

```

```

.elements = new Array();
.prototype.remove = Array_Remove;
.prototype.add = Array_Add;
.load = JSXMLElement_load;
.element = JSXMLElement_element;
.addElementAt = JSXMLElement_addElementAt;
.insertElementAt = JSXMLElement_insertElementAt;
.removeElement = JSXMLElement_removeElement;
.generateXML = JSXMLElement_generateXML;
.moveElement = JSXMLElement_moveElement;
}
JSXMLElement_load(strXML, xmleElem) {
    .XML = strXML;
    (!xmleElem) {
        (strXML.length) xmleElem = (new REXML(strXML)).rootElement;
        return false;
    }
    xmlBuilder = new JSXMLElementIterator(xmleElem);
    (true) {
        (xmlBuilder.xmleElem.type == "element") {
            (xmlBuilder.xmleElem.attributes) {

                .addElementAt(xmlBuilder.xmleElem.name,xmlBuilder.xmleElem.attributes,
xmlBuilder.xmleElem.text, this.elements.length, xmlBuilder.iElemLevel);
            } else {

                .addElementAt(xmlBuilder.xmleElem.name,xmlBuilder.xmleElem.attributeString,
xmlBuilder.xmleElem.text, this.elements.length, xmlBuilder.iElemLevel);
            }
        }
        (!xmlBuilder.getNextNode(false)) break;
    }
    (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
}
JSXMLElement_element(iIndex) {
    this.elements[iIndex];
}
JSXMLElement_addElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {
    = parseInt(iElemIndex);
    = parseInt(iElemLevel);
    (iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex =
(this.elements.length>0) ? this.elements.length-1 : 0;
    (iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel =
this.elements[iElemIndex-1].level;
    (!Attributes) Attributes = "";
    Elem = new Array();
    iAddIndex = iElemIndex;
    (iElemIndex > 0) {

```

```

        (var i=iElemIndex; i<this.elements.length; i++) if (this.elements[i].level >
iElemLevel) iAddIndex++;
        if (this.elements[i].level <= this.elements[iElemIndex].level) break;
        = new
JSXMLBuilder_XMLElement(strElement,Attributes,strText,iElemLevel+1,this);
    } else {
        = new JSXMLBuilder_XMLElement(strElement,Attributes,strText,1,this);
    }
    .elements = this.elements.add(iAddIndex,Elem);
    (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
}
JSXMLBuilder_insertElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {
    = parseInt(iElemIndex);
    = parseInt(iElemLevel);
    (iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex =
(this.elements.length>0) ? this.elements.length-1 : 0;
    (iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel =
this.elements[iElemIndex-1].level;
    (!Attributes) Attributes = "";
    Elem = null;
    iAddIndex = iElemIndex;
    (iElemIndex > 0 && iElemLevel > 0) {
        = new
JSXMLBuilder_XMLElement(strElement,Attributes,strText,iElemLevel+1,this);
    } else {
        = new JSXMLBuilder_XMLElement(strElement,Attributes,strText,1,this);
    }
    .elements = this.elements.add(iAddIndex,Elem);
    (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
}
JSXMLBuilder_removeElement(iElemIndex) {
    = parseInt(iElemIndex);
    (var iAfterElem=iElemIndex+1; iAfterElem<this.elements.length; iAfterElem++) if
(this.elements[iAfterElem].level < this.elements[iElemIndex].level+1) break;
    .elements =
this.elements.slice(0,iElemIndex).concat(this.elements.slice(iAfterElem,this.elements.length));
    (var i=iElemIndex; i<this.elements.length; i++) this.elements[i].index = i;
}
JSXMLBuilder_moveElement(iElem1Index,iElem2Index) {
    arrElem1Elements = new Array(this.elements[iElem1Index]);
    arrElem2Elements = new Array(this.elements[iElem2Index]);
    (var i=iElem1Index; i<this.elements.length; i++) if (this.elements[i].level >
this.elements[iElem1Index].level) arrElem1Elements[arrElem1Elements.length] = this.elements[i];
    else if (i>iElem1Index) break;
    (var i=iElem2Index; i<this.elements.length; i++) if (this.elements[i].level >
this.elements[iElem2Index].level) arrElem2Elements[arrElem2Elements.length] = this.elements[i];
    else if (i>iElem2Index) break;
    arrMovedElements = new Array();
    (iElem1Index < iElem2Index) {

```

```

        (i=0; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length] =
this.elements[i]; // start to the 1st element
        (i=iElem1Index+arrElem1Elements.length;
i<iElem2Index+arrElem2Elements.length; i++) arrMovedElements[arrMovedElements.length] =
this.elements[i]; // end of 1st element to end of 2nd element
        (i=0; i<arrElem1Elements.length; i++)
arrMovedElements[arrMovedElements.length] = arrElem1Elements[i]; // 1st element and all child
elements
        (i=iElem2Index+arrElem2Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 2nd element to end
        .elements = arrMovedElements;
    } else {
        (i=0; i<iElem2Index; i++) arrMovedElements[arrMovedElements.length] =
this.elements[i]; // start to the 2nd element
        (i=0; i<arrElem1Elements.length; i++)
arrMovedElements[arrMovedElements.length] = arrElem1Elements[i]; // 1st element and all child
elements
        (i=iElem2Index; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length]
= this.elements[i]; // 2nd element to 1st element
        (i=iElem1Index+arrElem1Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 1st element to end
        .elements = arrMovedElements;
    }
    (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
}
JSXMLBuilder_generateXML(bXMLTag) {
    strXML = "";
    arrXML = new Array();
    (bXMLTag) strXML += '<?xml version="1.0"?>\n\n'
    (var i=0; i<this.elements.length; i++) {
        += RepeatChar("\t",this.elements[i].level-1);
        += "<" + this.element(i).name // open tag
        (this.element(i).attributes) {
            (var j=0; j<this.element(i).attributes.length; j++) { // set attributes
                (this.element(i).attributes[j]) {
                    += ' ' + this.element(i).attributes[j][0] + '=' +
this.element(i).attributes[j][1] + "";
                }
            }
        } else strXML += this.element(i).attributeString.replace(/[>]$/gi, "");
        (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next
element is a lower or equal to
        (!this.elements[i+1] && this.elements[i-1])) // no next element,
previous element
        && this.element(i).text == "") {
            += "/";
        }
        += ">";
        (this.element(i).text != "") strXML += this.element(i).text;
    }
}

```

```

        strXML += "\n";
        (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next
element is a lower or equal to
        (!this.elements[i+1] && this.elements[i-1])) // no next element,
previous element
        && this.element(i).text != "") strXML += "</" + this.element(i).name
+ ">\n";
        (!this.elements[i+1]) {
            = i;
            (var j=i; j>-1; j--) {
                (this.elements[j].level >= this.elements[i].level) continue;
                {
                    (this.elements[j].level < this.elements[lastelem].level) {
                        += RepeatChar("\t",this.elements[j].level-1) + "</" +
this.element(j).name + ">\n";
                        = j;
                    }
                }
            }
        } else {
            (this.elements[i+1].level < this.elements[i].level) {
                = i;
                (var j=i; this.elements[j].level>=this.elements[i+1].level; j--) {
                    (this.elements[i] && this.elements[j] && this.elements[j].level
< this.elements[i].level && this.elements[j].level < this.elements[lastelem].level) {
                        += RepeatChar("\t",this.elements[j].level-1) + "</" +
this.element(j).name + ">\n";
                        = j;
                    }
                }
            }
        }
        (strXML.length > 1000) {
            [arrXML.length] = strXML;
            = "";
        }
    }
    [arrXML.length] = strXML;
    arrXML.join("");
}
JSXMLBuilder_XMLElement(strName,Attributes,strText,iLevel,xmlBuilder) {
    .type = "element";
    .name = strName;
    .attributes = (typeof(Attributes) != "string") ? Attributes : null;
    .attributeString = (typeof(Attributes) == "string") ? Attributes : "";
    .text = strText;
    .level = iLevel;
    .index = -1;
    .xmlBuilder = xmlBuilder;
}

```

```

.parseAttributes = JSXMLElement_parseAttributes;
.attribute = JSXMLElement_attribute;
.setAttribute = JSXMLElement_setAttribute;
.removeAttribute = JSXMLElement_removeAttribute;
.parentElement = JSXMLElement_parentElement;
.childElement = JSXMLElement_childElement;
}
JSXMLElement_parseAttributes() {
    (!this.attributes) {
        reAttributes = new RegExp("([^\s]*)=", "g"); // matches attributes
        (this.attributeString.match(reAttributes) &&
this.attributeString.match(reAttributes).length) {
            arrAttributes = this.attributeString.match(reAttributes);
            (!arrAttributes.length) arrAttributes = null;
            for (var j=0; j<arrAttributes.length; j++) {
                [j] = new Array(
                    (arrAttributes[j]+"").replace(/[/= ]/g, ""),
                    (this.attributeString, (arrAttributes[j]+"").replace(/[/=
]/g, ""))
                );
            }
            .attributes = arrAttributes;
        }
    }
}

JSXMLElement_attribute(AttributeName) {
    (!this.attributes) this.parseAttributes();
    (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] ==
AttributeName) return this.attributes[i][1];
    "";
}

JSXMLElement_setAttribute(AttributeName, Value) {
    (!this.attributes) this.parseAttributes();
    (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] ==
AttributeName) {
        .attributes[i][1] = Value;
        ;
    }
    .attributes[this.attributes.length] = new Array(AttributeName, Value);
}

JSXMLElement_removeAttribute(AttributeName, Value) {
    (!this.attributes) this.parseAttributes();
    (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] ==
AttributeName) {
        .attributes = this.attributes.remove(i);
        ;
    }
}

```



```

    JSXMLElement_parentElement() {
        (var i=this.index; this.xmlBuilder.element(i) && this.xmlBuilder.element(i).level !=
this.level-1; i--);
        this.xmlBuilder.element(i);
    }
    JSXMLElement_childElement(Child) {
        iFind = -1;
        (var i=this.index+1; i<this.xmlBuilder.elements.length; i++) {
            (this.xmlBuilder.elements[i].level == this.level+1) {
                ++;
                (iFind == Child || this.xmlBuilder.elements[i].name == Child) return
this.xmlBuilder.elements[i];
            } else if (this.xmlBuilder.elements[i].level <= this.level) break;
        }
        null;
    } JSXMLElementIterator(xmlElem) {
        .xmlElem = xmlElem;

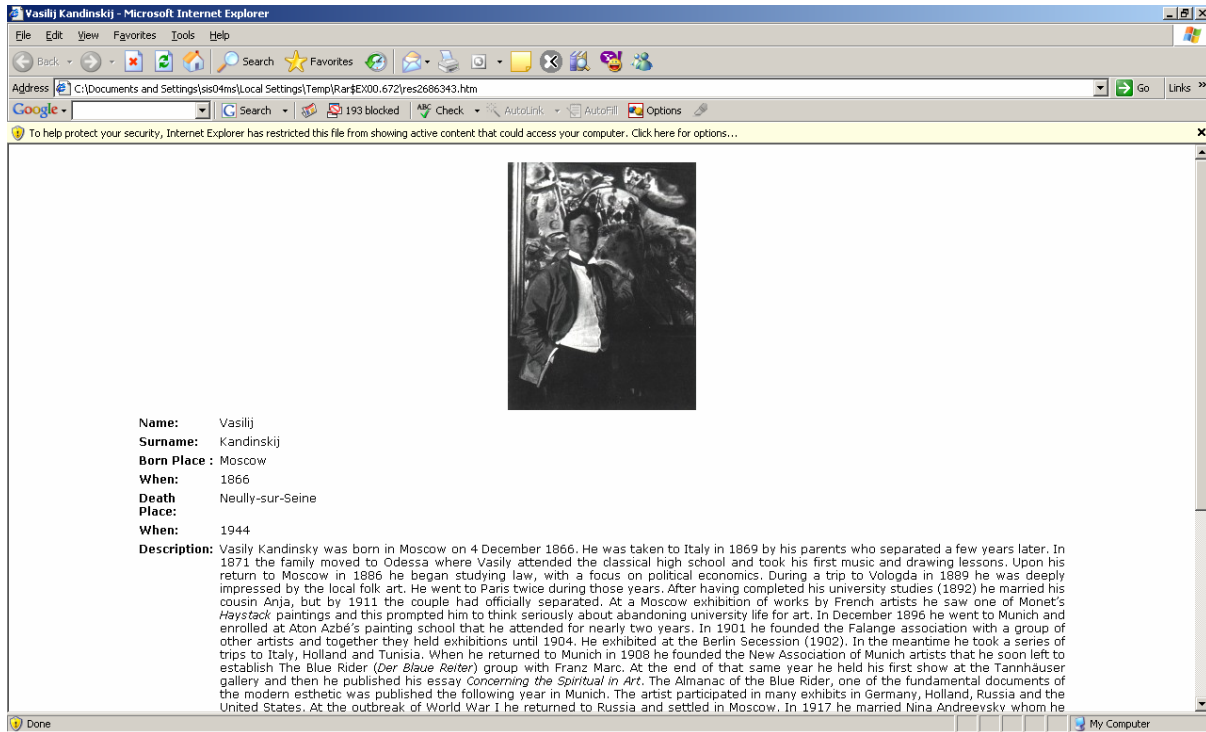
        .iElemIndex = 0;
        .arrElemIndex = new Array(0);
        .iElemLevel = 0;
        .iElem = 0;
        .arrElemIndex[this.iElemLevel] = -1;
        .getNextNode = JSXMLElementIterator_getNextNode;
    }
    JSXMLElementIterator_getNextNode() {
        (!this.xmlElem || this.iElemLevel<0)false;
        (this.xmlElem.childElements.length) { // move up
            .arrElemIndex[this.iElemLevel]++;
            .iElemIndex++;
            .iElemLevel++;
            .arrElemIndex[this.iElemLevel] = 0;
            .xmlElem = this.xmlElem.childElements[0];
        } else { // move next
            .iElemIndex++;
            .arrElemIndex[this.iElemLevel]++;
            (this.xmlElem.parentElement &&
this.xmlElem.parentElement.childElements.length && this.arrElemIndex[this.iElemLevel] <
this.xmlElem.parentElement.childElements.length) this.xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
            {
                (this.iElemLevel>0) { // move down
                    (; this.iElemLevel > 0; this.iElemLevel--) {
                        (this.xmlElem.parentElement &&
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]]) {
                            .xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
                            .iElemLevel++;
                        }
                    }
                }
            }
        }
    }

```

```

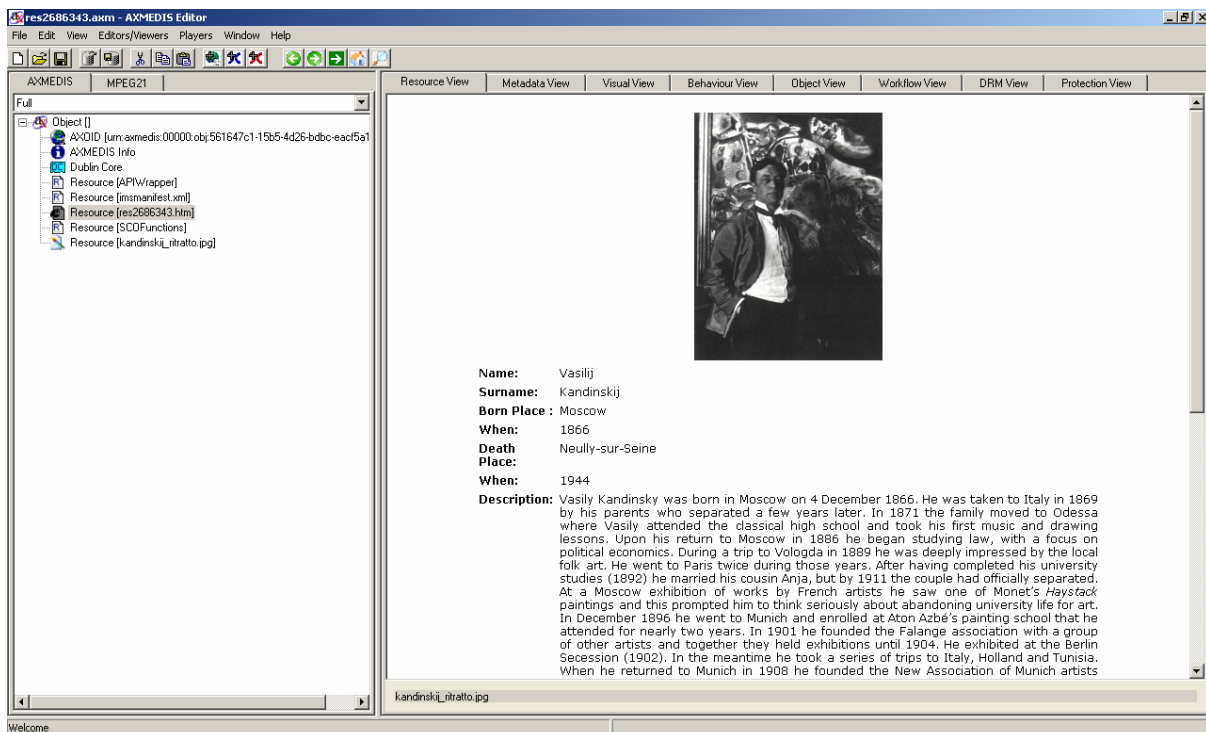
        .arrElemIndex =
this.arrElemIndex.slice(0,this.iElemLevel+1);
        ;
        } else {
        .xmleElem = this.xmleElem.parentElement;
        }
    }
    .iElemLevel--;
    } else {
    false;
    }
    }
    }
    (typeof(this.xmleElem) == "object" && this.iElemLevel > -1);
    }ParseAttribute(str,Attribute) {
str = str + ">";
(str.indexOf(Attribute + "=")>-1) var Attr = new RegExp(".*" + Attribute + "='([^']*).*>");
if (str.indexOf(Attribute + "=")>-1) var Attr = new RegExp(".*" + Attribute + "='([^']*).*>");
str.replace(Attr, "$1");
}Array_Remove(c) {
tmparr = new Array();
(var i=0; i<this.length; i++) if (i!=c) tmparr[tmparr.length] = this[i];
tmparr;
}Array_Add(c, cont) {
tmparr = new Array();
(var i=0; i<this.length; i++) {
    (i==c) tmparr[tmparr.length] = cont;
    [tmparr.length] = this[i];
}
(!tmparr[c]) tmparr[c] = cont;
tmparr;
}RepeatChar(sChar,iNum) {
L = "";
(var i=0; i<iNum; i++) L += sChar;
L;
}]]>
</JS_Script>
</Rule_Body>
<Dependencies/>
</AXCP_Rule>
</Definition>
</Rule>

```



**Figure 2.8: The original IMS Learning Object**

The following is the AXMEDIS Object produced by executing the rule on the IMS Object Above.



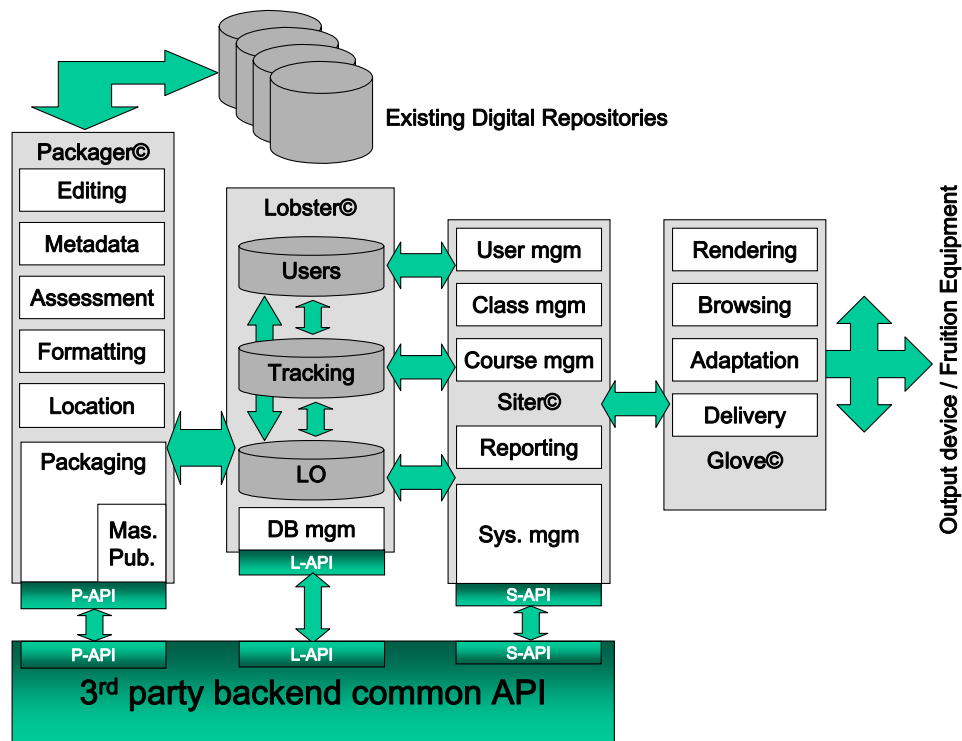
**Figure 2.9: AXMEDIS Object produced from the IMS Object**

## 2.4 Integration of ILABS Content Sources to the AXMEDIS Model (ILABS)

The present section focuses on the integration between AXMEDIS system and *learn eXact*® Mobile (LEX-Mobile). The AXMEDIS system has been described in other relevant documents (reported also in the reference section) it is now time to provide a description of LEX system. LEX is a proprietary environment developed in GIUNTI Interactive Labs during the past ten years and devoted to cover the whole value chain of e-learning publishing and fruition in full compliancy with international standards. The Mobile edition allows management of delivery to mobile devices. Basically it comprises the following elements:

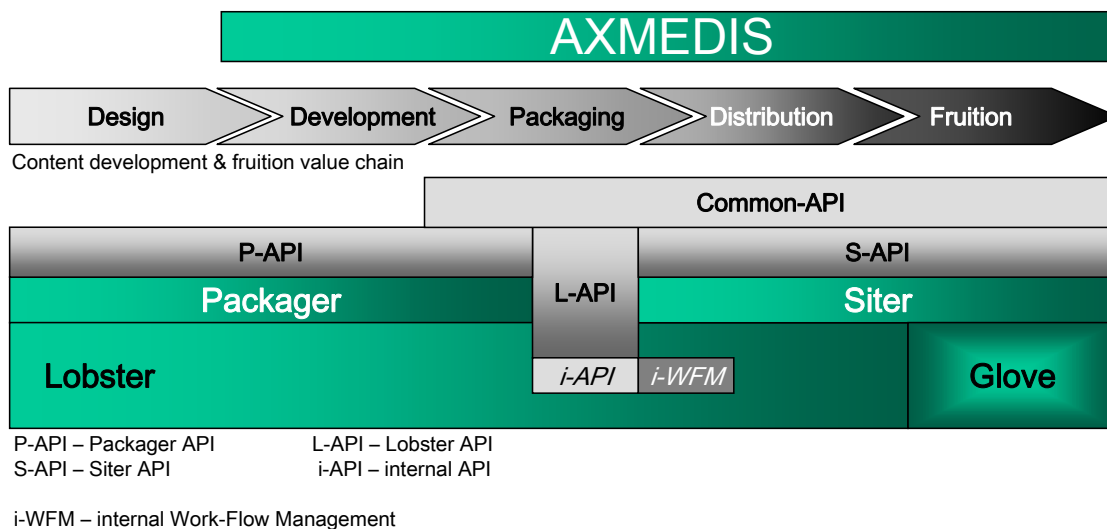
- *Packager*® - the authoring and packaging facility of the *learn eXact*® platform;
- *Lobster*® - the data manager that handles all published content of the *learn eXact*® platform;
- *Siter*® - the e-learning management module of the *learn eXact*® platform;
- *Glove*® - the e-learning rendering and fruition module of the *learn eXact*® platform;
- D-Repository - any repository compliant to the *Digital Repository* standard (WebCT, BlackBoard...)
- Back-end - any existing backend compliant with the set of API exposed by *learn eXact*® platform.

The most relevant aspect in the D-Repository connection is the possibility of using their content either as source or destination of the packaging process as all that is needed is the compatibility with IMS packaging standard. This feature was developed originally to grant users the possibility of continuing to exploit the already existing content sources or distribution facilities and infrastructure even in the case of a shift in either production or delivery framework. The same principle is brought to the development of a set of API for interconnecting with external back-ends; this is actually the way that will be followed to allow AXMEDIS empowered production and distribution value chain to be exploited. As stated in the TA it is expected that each distributor may keep on using own distribution media, but should also take advantage of the powerful support provided by AXMEDIS. Given the layered structure of GIUNTI Authoring and Learning Environment, this has been possible operating at API level in the area previously generically marked as “backend” (for example SAP...). More specifically it has been necessary to define a set of new API to allow AXMEDIS co-operation with the new third party environment. The following schema explains this in more detail:



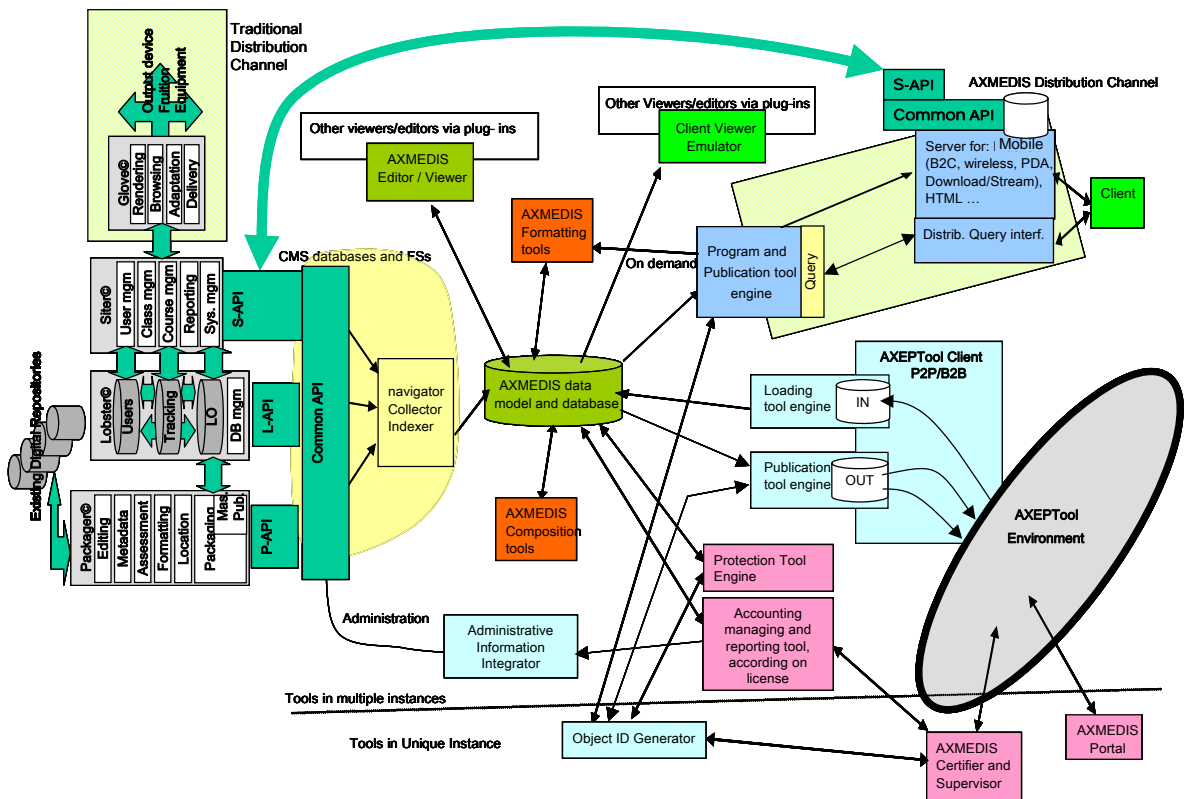
**Figure 2.10: Block Diagram for Mobile Distribution**

From the above diagram it is evident that the two environments always have a “mediated” interaction, and this is achieved through proper API sets. Having said this it is necessary to examine in more detail the level of functionalities covered by the various set of API in respect to the process value-chain. In the following diagram the possible level of interaction between AXMEDIS as a backend and our environment is summarised. The set of common API allows interaction mainly at packaging, distribution and fruition level (at least as far as content delivery is concerned) even though the rendering tool (Glove) is designed only for e-learning purposes and therefore is not compatible with the overall aim of the project. On the other hand during the design and development phase the possibility of interaction is limited (especially at the design phase) to data import/export.



**Figure 2.11: Global Workflow Management**

From the above schema it is evident that the Lobster embeds a workflow management system used to handle cooperative editing of content. The packager can toggle, via internal API, the status of a package (LO (for Learning Object or course)) between the status of “locked” and “unlocked” while the Siter can manage, via internal API, all states of the package. The internal API is implemented via web-service and it is not exposed to the backend. Having stated this it is now necessary to see how the overall architecture will look like at the end of the integration phase.

**Figure 2.12: Global Architecture for Mobile Distribution**

Interaction will basically occur at the level of the CMS and file system thanks to the 3rd party backend common API as highlighted in the picture above. It is worth mentioning that the schema is an adaptation of the one describing AXMEDIS architecture and reported both in the TA and in the framework specifications. The only relevant change is the one depicting the interaction between AXMEDIS (seen here as a backend) and the GIUNTI Authoring and Learning Environment.

### **3 State-Of-The-Art Device Update (UR, FUPF)**

#### **3.1 Trends in Digital Media Adaptation & Transcoding (UR)**

Over the period the trend towards the adoption of the MPEG-21 standard re digital item adaptation has been more established and the relevant RTD in AXMEDIS has responded to that as described in [1].

The main thrust of the other developments in this area over the recent period has tended to focus on automated on-the-fly Service Level Agreement (SLA) negotiation and dynamic transcoding mainly to optimise network bandwidth utilisation and security protection. This is to enhance of the capability of telecommunication networks for secure traffic management on the one hand, and, to optimise tasking and load balancing of service provisioning in Grid-enabled networks.

All these trends are predicated on advancing the semantic expressiveness of the representations that together constitute the media delivery context in terms of a number of usage conditions relating to the network session and client device (both generic and individual) capabilities, and, user preferences including location-based requirements. As such there has been a continuing interest in enhancing the standards to allow more expressive integrative and open semantic parameterisation of the delivery context including the deployment of generalisation ontologies, for example as advocated earlier in [2], that would enable proxy-enabled SLA negotiation and advanced personalisation particularly in the context of security and trust services.

To the extent that the adoption of an appropriately partitioned and standards-compliant set of user preferences hierarchies is fundamental to all the above, our work in this area has built on the latest state-of – the art and extended it to provide increased semantic parameterisation of the media delivery context through adopting the MPEG-21 DIA for Digital Item Adaptation to which we have added additional semantic elements for our own profiling management to serve the Digital Media Adaptation, Transcoding Services to be provided by the AXMEDIS Framework

MPEG-21 is a multimedia standards framework devised to support a simplified, open and interoperable multimedia delivery and consumption chain and thus motivate an open market for content creators, producers, distributors, service providers and content consumers.

MPEG-21 is based on two essential concepts namely the definition of a fundamental unit of distribution and transaction (the Digital Item) and the concept of Users interacting with the Digital Items. Its goal is to define the technology needed to support Users to exchange, access, consume, trade and otherwise manipulate Digital Items in an efficient, transparent and interoperable way.

The Digital Item Adaptation (DIA) section is one of the 17 constituent parts of the MPEG-21 standard. This is elaborated by defining the syntax and semantics of the various aspects relevant to the media delivery context as deployed in our work in this period, the main elements of which are outlined below.

##### **3.1.1 Digital Item Adaptation for Delivery Context Representation**

MPEG-21 motivates the shielding of users from issues relating to network and terminal installation, management and implementation by offering interoperable transparent access to distributed advanced multimedia content. The MPEG-21-enabled vision is to enable on-demand adaptation of the Digital Item for delivery to client terminals so that multimedia content can be created and ubiquitously shared, always with the agreed/contracted quality, reliability and flexibility. Digital Items are subject to a resource adaptation engine, as well as a descriptor adaptation engine, which together produce the adapted Digital Items.

The target for this part of the standard is to specify tools that provide input to the adaptation engine, so that any constraints on the delivery and consumption of resources can be satisfied, and the quality of the user experience can be guaranteed.

Digital Item adaptation comprises of the User Characteristics, Terminal Capabilities, Network Characteristics, Natural Environment Characteristics, Resource Adaptability and Session Mobility.

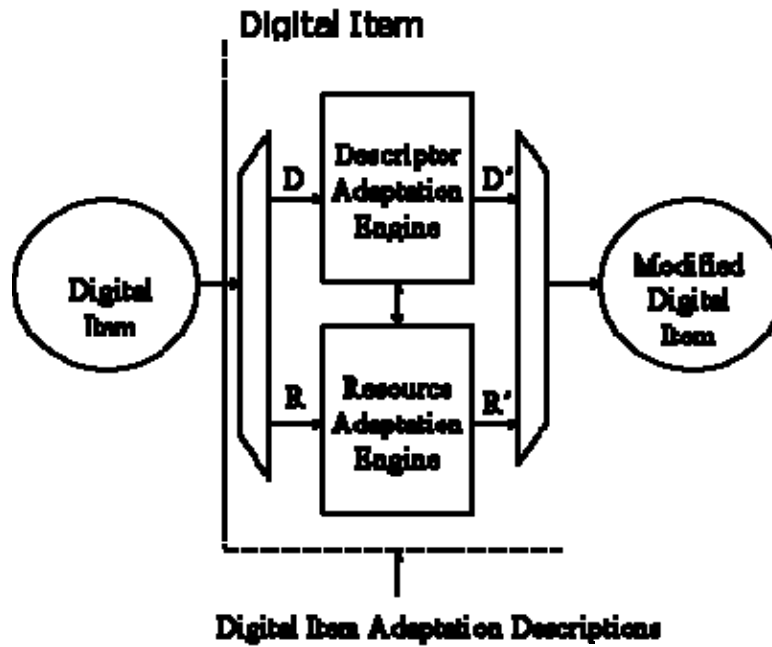


Figure 3.1: Digital Item Adaptation

### 3.2 DRM Support and Interoperability (FUPF)

This section describes the update on different rights expression languages considered from the point of view of the DRM Support for mobiles and interoperability.

#### 3.2.1 REL Profiles

An MPEG REL profile consists of a subset of the MPEG REL with some application oriented extensions in terms of its types, elements, attributes and authorisation model, and is usually defined as the result of first extending (when needed) and then profiling the language with the extensions. Extending the REL enables users of the REL to define new types, elements and attributes specific to their needs. This includes extending the REL schematic elements with new ones for new basic entities of the REL, namely, principal, right, resource and condition, to improve efficiency in a specific domain. Profiling the REL enables users to select only those language elements, as a subset of the language, required to meet a specific application need. This optimises payload of digital items and computation requirements of MPEG terminals. An MPEG REL profile, resulting from extending and profiling the REL, can thus be used to optimise the applicability of the REL to one specific application.

#### 3.2.2 The REL MAM Profile



The MPEG-21 REL MAM profile is for distributing and consuming content delivered via channels including mobile communications and pre-recorded optical media to devices like mobile phones and high-definition DVD players.

To support applications in the mobile and optical media domains, the MAM profile extends the MPEG REL with the following elements:

- *Principals* identified with identifiers from a given identification system.
- *Rights* to copy and move digital resources according to pre-determined rules defined by some governance organisation.
- *Resources* protected by some form of (symmetric key and/or public key) encryption.
- *Conditions* to derive digital resources based on their relations with other resources when creating a collection of resources like a play-list and a customised movie, conditions to copy, move and output digital resources to other DRM systems, and conditions to seek dynamic permissions at the time of using digital resources.

The MAM profile consists of elements for:

- *Principals* that can be identified by either an identifier in some identification system or a cryptographic key.
- *Rights* to play, print and execute resources, to copy and move according to rules defined by a governance body, and to possess attribute properties (related to, say, subscribers or authorisation domains).
- *Resources* whose confidentiality and integrity are protected or not protected.
- *Conditions* related to time intervals, usage counts and territories, conditions to copy, move and output digital resources to other DRM systems, and conditions to seek dynamic permissions at the time of using digital resources.

The MAM profile supports usage models such as:

- Unrestricted usage
- Usage tied to individuals
- Preview
- Super-distribution
- Subscription based usage
- Usage within authorized domains

## 4 Work Done in Digital Item Adaptation (UR, DSI, DIPITA, EPFL, FHGIGD)

### 4.1 JSPROFILING (UR)

JSPROFILING consists of Java Script classes for User, Device and Network profiles which act as wrappers for corresponding C++ classes. These classes contain functions responsible for creating and managing the profiles with respect to different scenarios.

#### 4.1.1 JSAXUserProfile

The user's profile captures and stores information related to the users, the usage environment and the user preferences. This profile should be managed at the personalisation server and be able to store minimal details about the user to identify his personal preferences in respect to the services being offered. The elements in this profile are the minimal set of elements that are required to meet the AXMEDIS User's personalisation needs. Each of these elements is based on the definitions provided by the MPEG21 schema [ISO MPEG-21, Part 7 - Digital Item Adaptation, ISO/IEC JTC1/SC29/WG11/N5231, and (Oct 2002)]. The schema for this profile is contained in the AXMEDIS-user-profile.xsd. The JSUserProfile is a JS class to automatically create and manage user profiles as a part of rule scripts for the AXCP engine.

The functionalities and values for the user profiles can be accessed through the methods given below. These functions are only wrappers for the functions in the C++ class UserProfile.

- UserProfile: Constructor for Initialising the Profile
- loadXmlFile: Loads the Xml from file
- loadXmlString: Loads Xml from an Xml String
- createXmlfile: Creates an Xml file where the file is specified as uri
- getXml: Returns the contents of the XML file in String form
- setXml: Writes the string as the contents of the XML file
- getAttribute: It returns the corresponding value of the attributes from the xml file. Attributes for the respective profiles are specified in the Profiles documentation provided in [1]
- setAttribute: Sets individual values to the attributes of the xml file
- getValue: Returns the corresponding value of the element from the xml file. Possible Values for the respective profiles are specified in the Profiles documentation provided in [1]
- setValue: Sets individual values to the elements of the xml file
- createElement: Creates an xml element using the DomPath and Element Name
- deleteElement: Deletes an xml element based on the DomPath
- close: Closes the xml file. If any element is changed then the changes are saved and then the xml file is closed.

#### 4.1.2 JSAXDeviceProfile

The device profile captures information related to the user's device, that the service provider must take into account while delivering the multimedia contents. Generally the minimal set of elements required are those that affect the proper utilisation of the contents on the device e.g. screen resolution for images. This profile represents the characteristics of the user's personal device and hence contains the most vital information for the content providers that can be used to transcode the content to match the device characteristics and can be better utilised by the user. Each of these elements is based on the definitions provided by MPEG21 schema [ISO MPEG-21, Part 7 - Digital Item Adaptation, ISO/IEC JTC1/SC29/WG11/N5231, and (Oct 2002)]. The

schema for this profile is contained in the AXMEDIS-device-profile.xsd. The JSDeviceProfile is a JS-class to automatically create and manage Device profiles as a part of rule scripts for the AXCP engine.

The functionalities and values for the device profiles can be accessed through the methods similar to those outlined above for the User Profile. These functions are only wrappers for the functions in the c++ class DeviceProfile.

#### 4.1.3 JSaxNetworkProfile

Network profile captures information related to the carrier that is used for delivery of the content to the user's device. It is necessary for the distributors to know various characteristics of the Network so as to provide the promised QoS. The information contained in this profile can also be used to for transcoding of the content to better utilise both network and device capabilities. The elements in this profile are the minimal set of elements that are required to meet the AXMEDIS User's personalisation needs and to meet the distributor's needs in terms of the network capabilities.

Each of these elements is based on the definitions provided by MPEG21 schema [ISO MPEG-21, Part 7 - Digital Item Adaptation, ISO/IEC JTC1/SC29/WG11/N5231, and (Oct 2002)].

The schema for this profile is contained in the AXMEDIS-network-profile.xsd. The JSNetworkProfile is a JS class to automatically create and manage user profiles as a part of rule scripts for the AXCP engine. The JS\_NetworkProfile updates/retrieves the Network Profile stored in the database. The functionalities and values for the Network Profile can be accessed through methods similar to those outlined above for the User Profile.

Essentially, the stages involved in media adaptation for on-demand delivery to mobile devices include the representation of the relevant profile types using appropriate classes which can be interrogated dynamically using a profiling standard such as CC/PP, UAProf or MPEG-21 and thereafter invoking a suitable transcoding algorithm to adapt the delivery of the media to the client device.

Following extensive discussions within the AXMEDIS Consortium regarding User Profiling for Multimedia Distribution, it was concluded that the MPEG-21 standard should be adopted so as to accommodate all the possible scenarios. Accordingly each and every aspect of the MPEG-21 DIA was analysed in depth and suitable fields were adopted for the AXMEDIS profiles and in some cases some AXMEDIS specific values were added to the existing profile to enrich it to accommodate all AXMEDIS-related requirements. The schemas were defined in terms of three categories, namely User Profiles, Device Profiles and Network Profiles and were circulated amongst the partners for their feedback. This supported the schema specification for user profiling as finalised by way of the detailed schema specification as appeared in the document AXMEDIS-DE3-1-2-2-6-Spec-of-AX-Content-Processing-upC-v1-5). For the entire schema file please refer to the relevant xsd files. During this project period we have also been engaged in the process of developing the respective Javascript and C++ classes for creating and managing the profiles. The Javascript classes have been based on the mozilla spider monkey scripts and the C++ classes have been constructed as re-usable object models.

## 4.2 Ringtone Adaptation (UR)

Ringtone Adaptation refers to the adaptation of ringtones of popular formats to enhance the usability and manage the variable delivery to cater for heterogeneous client devices and user requirements on-demand. It uses external libraries like FFMPEG and TIMIDITY to convert a given ringtone from one format to another and to re-sample it based on the client device.

The following are the main functions described in the Ringtone Adaptation Module

*GetInfo*: Gets all the information about the input Ringtone like Mime type, Sampling Rate, Bit Rate, Number of Channels etc

*Convert*: Converts a ringtone to different formats. (E.g. from Wav to MP3)

*Re-sample*: Re-samples the input file (i.e. changing frequency, bitrate etc)

*Clip*: Clips the file to size it for the specified time (e.g. reducing it to a 30-second clip)

During this project period, we have updated all the functions for Ringtone transcoding and made sure that the ffmpeg libraries used were aligned with those deployed by other partners. Since the ffmpeg versions had their basic structures changed for creating the required new versions, re-aligning the libraries with other partners posed a bigger problem than had been anticipated. It involved re-writing of already completed code so as to make it compatible with the corresponding library. Naturally this required a lot of effort to make the functions consistent with the specifications. The other problems encountered were due to the lack of support for Timidity. Since its last version was written in 1997 the support available online currently is negligible and in our opinion, using a library with limited support is not advisable. Accordingly it is planned to exclude the Timidity from our list of supported functions in the next release.

### 4.3 Audio Adaptation (EPFL)

The audio adaptation functionalities have been integrated with the axeditor as plug-ins through the AXCP interface. The plug-in simply consists of a DLL and an XML file describing the functionalities of the DLL. Both the DLL and the XML description are installed in the plug-in directory of the AXCP compliant tool using the plug-in. The FFMPEG library and the LIBSNDFILE library have been used for the audio transcoding functionalities.

#### 4.3.1 FFmpeg Audio Transcoding

The FFmpeg Audio Transcoding functions are used to convert an audio file into a different format and/or codec. Apart from the bit rate reduction depending on the selected codec, one can further reduce the size of the resulting audio file by changing its sample rate and its number of audio channels. Moreover one can select only a specific portion of the input file to produce the resulting output file by specifying starting and ending points in the input file.

##### 4.3.1.1 Formal description of FFmpeg transcoding algorithm

**Description:** encode an audio file in another format or another codec and change its sample rate and number of audio channels if needed.

The generic syntax is:

*string* Transcoding(*AxResource* InputResource, *string* MimeType, *AxResource* OutputResource, *UINT32* OutputSamplingRate, *UINT16* OutputNumChannels, *UINT16* OutputBitRate, *float* ReadStartingTime, *float* ReadEndingTime, *string* OutputCodec)

#### Parameter List:

**Name:** InputResource

**Description:** the resource to be converted

**Parameter Type:** *AxResource*

**Default Value:**

**Constraints:**

**Resource Type:** audio

**Resource Format:** x-mpeg (.mp3), x-aiff (.aif, .aiff), x-wav (.wav), basic (.au, .snd), x-ms-wma (.wma), x-vorbis (.ogg), x-pn-realaudio (.ra, .ram)

**Ranges:**

**Name:** *MimeType*

**Description:** MimeType for the output resource

**Parameter Type:** *string*

**Default Value:**

**Constraints:**

**Resource Type:** audio

**Resource Format:** x-mpeg, x-aiff, x-wav, basic, x-vorbis, x-ac3

**Ranges:**

**Name:** *OutputResource*

**Description:** Where the output resource will be stored

**Parameter Type:** *AxResource*

**Default Value:**

**Constraints:**

**Range:**

**Name:** *OutputSamplingRate*

**Description:** The sampling rate of the output resource in Hertz

**Parameter Type:** *uint32*

**Default Value:** by default, the sampling rate of the input resource is used

**Constraints:**

**Range:**

**Name:** *OutputNumChannels*

**Description:** The number of channels of the audio resource after transcoding

**Parameter Type:** *uint16*

**Default Value:** by default, the number of channels of the input resource is used

**Constraints:**

**Range:**

**Name:** *OutputBitRate*

**Description:** The bit rate of the audio resource after transcoding in kilo-Bytes (this parameter is used when transcoding towards a compressed audio format such as MP3)

**Parameter Type:** *uint16*

**Default Value:** by default, the bit rate is set to 64 kB

**Constraints:**

**Range:**

**Name:** *ReadStartingTime*

**Description:** set the beginning of the output resource to *ReadStartingTime* seconds from the beginning of the input resource

**Parameter Type:** *float*

**Default Value:** by default, the read starting time is set to 0 seconds which means that the input resource is considered from the beginning

**Constraints:**

**Range:**

**Name:** ReadEndingTime

**Description:** set the end of the output resource at *ReadEndingTime* seconds from the beginning of the input resource

**Parameter Type:** *float*

**Default Value:** by default, the read ending time is set to the end of the input resource

**Constraints:**

**Range:**

**Name:** OutputCodec

**Description:** set the codec of the output resource; depending on the mime type selected for the output resource, only a certain subset of codec will be supported (the following table shows the possible codecs according to the possible mime types)

**Parameter Type:** *string*

**Default Value:** the default codec depend on the mime type selected for the output resource (the following table shows the default codec according to the possible mime types)

**Constraints:**

**Range:**

**Result:** Result

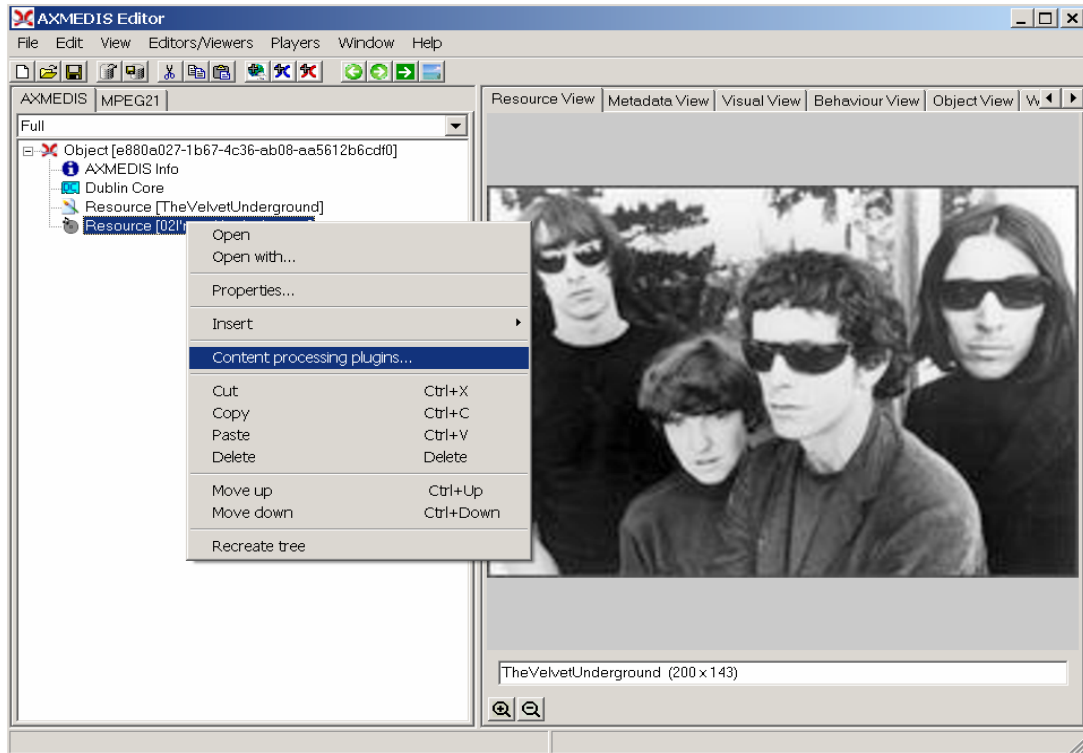
**Result Type:** string

**Result Description:** the result of conversion, SUCCESS if ok, ERROR followed by a message in case of error

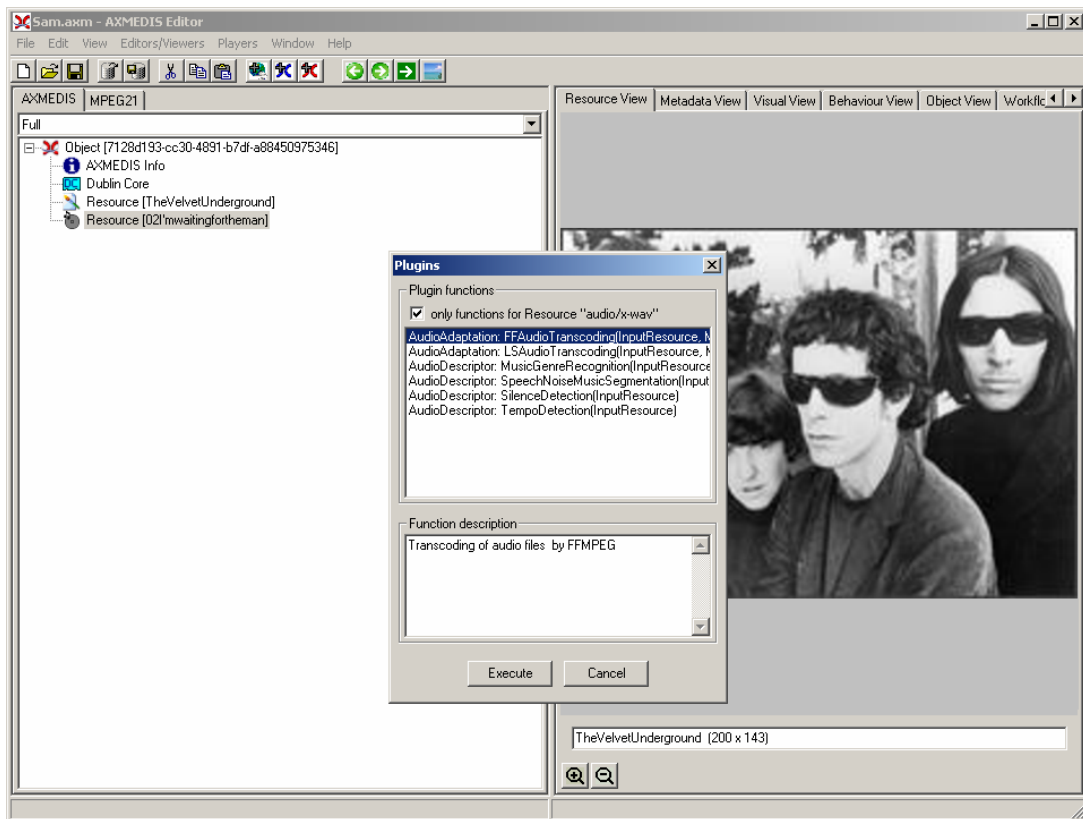
#### 4.3.1.2 FFmpeg Audio Transcoding Plug-in

The following demonstrates the FFmpeg audio adaptation transcoding function as a plug-in integrated with for the AXMEDIS editor.

The plug-in must be applied on an audio resource of an AXMEDIS object. The adaptation plug-in is called by right-clicking on the interesting resource and selecting the 'Plugin...' command:



A window showing the functionalities available for the kind of resource selected appears:



The first audio adaptation function available is the FFmpeg transcoding function which is selected by clicking on **FFAudioAdaptation: FFAudioTranscoding**. A new window appears showing the interface to the audio transcoding function. In the example of the following figure, the transcoding function is used to create a 10 second snapshot with reduced bit rate of the input audio file:

- Mp3 compression is selected with a bit rate of 64 kB (which corresponds to a low quality)
- Further bit rate reduction is achieved by using a lower sampling rate for the output (22050 Hz) and mixing audio channels into a single mono channel
- Only a portion of 10 seconds of the input resource is selected (starting at time 10 seconds and ending at time 20 seconds)

A snapshot with reduced bit rate is particularly useful to allow a customer to pre-view an item before purchasing the corresponding high quality object.

### 4.3.2 Libsndfile

#### *Libsndfile Audio Transcoding*

The libsndfile Audio Transcoding function are used to convert an audio file into a different format and/or codec. Apart from the bit rate reduction depending on the selected codec, one can further reduce the size of the resulting audio file by changing its sample rate and its number of audio channels. Moreover one can select only a specific portion of the input file to produce the resulting output file by specifying starting and ending points in the input file.

#### 4.3.2.1 Formal description of libsndfile transcoding algorithm

**Description:** encode an audio file in another format or another codec and change its sample rate and number of audio channels if needed.



**Signature:**

*string* Trancoding(*AxResource* InputResource, *string* MimeType, *AxResource* OutputResource, *float* ReadStartingTime, *float* ReadEndingTime, *string* OutputCodec)

**Parameter List:**

- Name:** InputResource  
**Description:** the resource to be converted  
**Parameter Type:** *AxResource*  
**Default Value:**  
**Constraints:**  
    **Resource Type:** audio  
    **Resource Format:** x-mpeg (.mp3), x-aiff (.aif, .aiff), x-wav (.wav), basic (.au, .snd), x-ms-wma (.wma), x-vorbis (.ogg), x-pn-realaudio (.ra, .ram)  
**Ranges:**
- Name:** MimeType  
**Description:** MimeType for the output resource  
**Parameter Type:** *string*  
**Default Value:**  
**Constraints:**  
    **Resource Type:** audio  
    **Resource Format:** x-mpeg, x-aiff, x-wav, basic, x-vorbis, x-ac3  
**Ranges:**
- Name:** OutputResource  
**Description:** Where the output resource will be stored  
**Parameter Type:** *AxResource*  
**Default Value:**  
**Constraints:**  
**Range:**
- Name:** ReadStartingTime  
**Description:** set the beginning of the output resource to *ReadStartingTime* seconds from the beginning of the input resource  
**Parameter Type:** *float*  
**Default Value:** by default, the read starting time is set to 0 seconds which means that the input resource is considered from the beginning  
**Constraints:**  
**Range:**
- Name:** ReadEndingTime  
**Description:** set the end of the output resource at *ReadEndingTime* seconds from the beginning of the input resource  
**Parameter Type:** *float*  
**Default Value:** by default, the read ending time is set to the end of the input resource  
**Constraints:**  
**Range:**
- Name:** OutputCodec

**Description:** set the codec of the output resource; depending on the mime type selected for the output resource, only a certain subset of codec will be supported (the following table shows the possible codecs according to the possible mime types)

**Parameter Type:** *string*

**Default Value:** the default codec depend on the mime type selected for the output resource (the following table shows the default codec according to the possible mime types)

**Constraints:**

**Range:**

**Result:** Result

**Result Type:** string

**Result Description:** the result of conversion, SUCCESS if ok, ERROR followed by a message in case of error

#### **Libsndfile supported types and codecs:**

For a list of codecs and formats supported by the Libsndfile library, please refer to section 34.5.

#### **Mime Type accepted :**

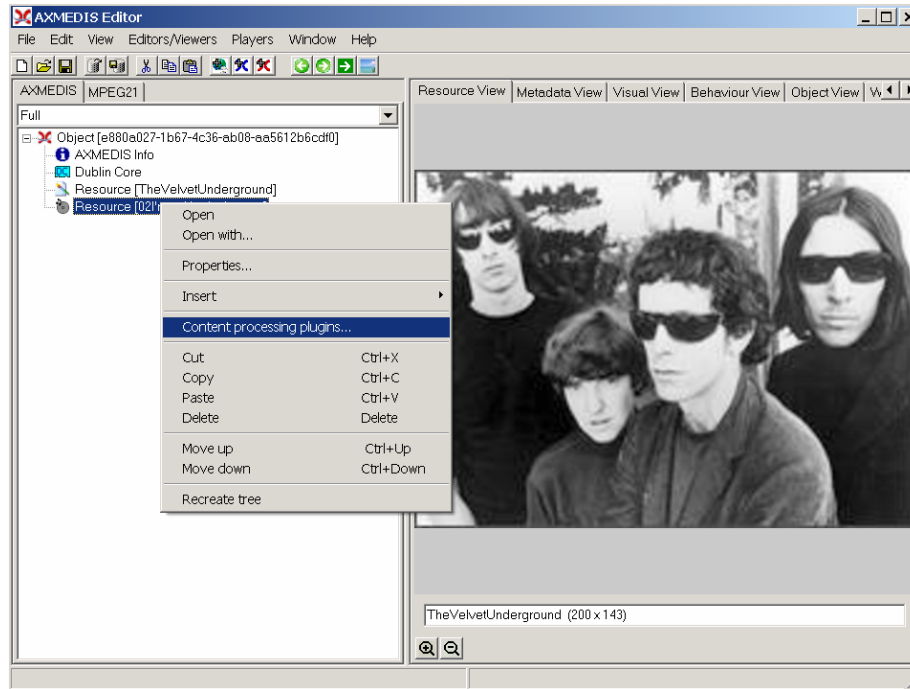
audio/x-wav  
audio/x-basic  
audio/x-paris  
audio/x-svx  
audio/x-nist  
audio/x-voc  
audio/x-ircam  
audio/x-w64  
audio/x-sd2  
audio/x-flac  
application/x-pcm  
application/x-pagerecall

Here's an example on how to use the libsndfile audio adaptation transcoding function as a plug-in with for the AXMEDIS editor.

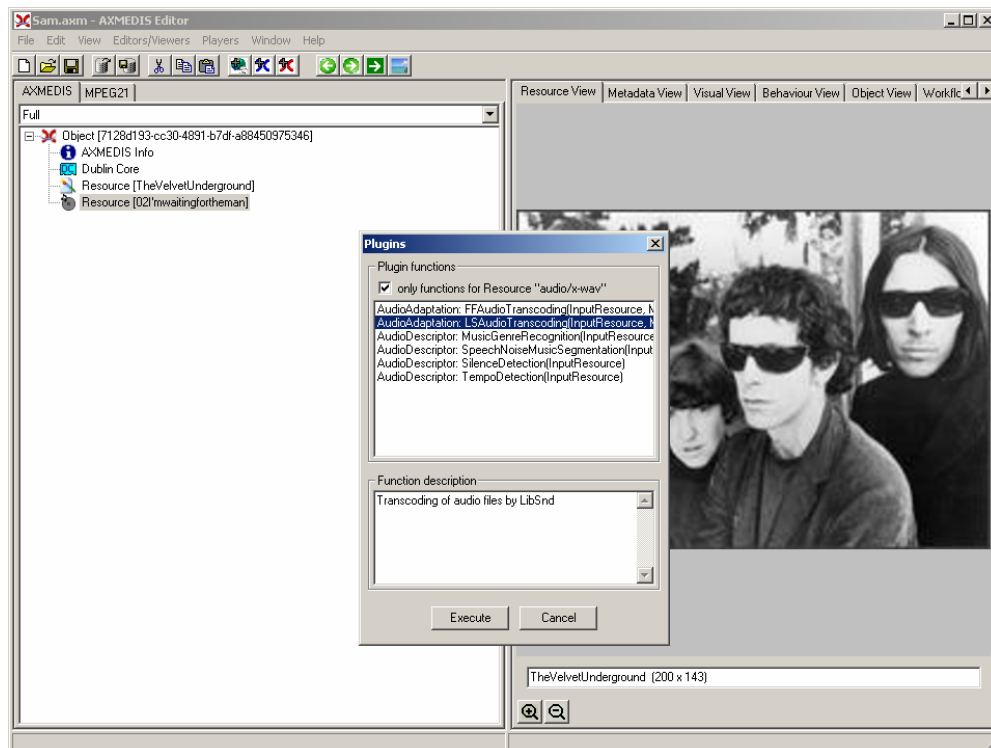
#### **4.3.2.2 Libsndfile AudioTranscoding Plug-in**

The following demonstrates the libsndfile audio adaptation transcoding function as a plug-in integrated with for the AXMEDIS editor.

The plug-in must be applied on an audio resource of an AXMEDIS object. The adaptation plug-in is called by right-clicking on the interesting resource and selecting the 'Plugin...' command:



A window showing the functionalities available for the kind of resource selected appears:

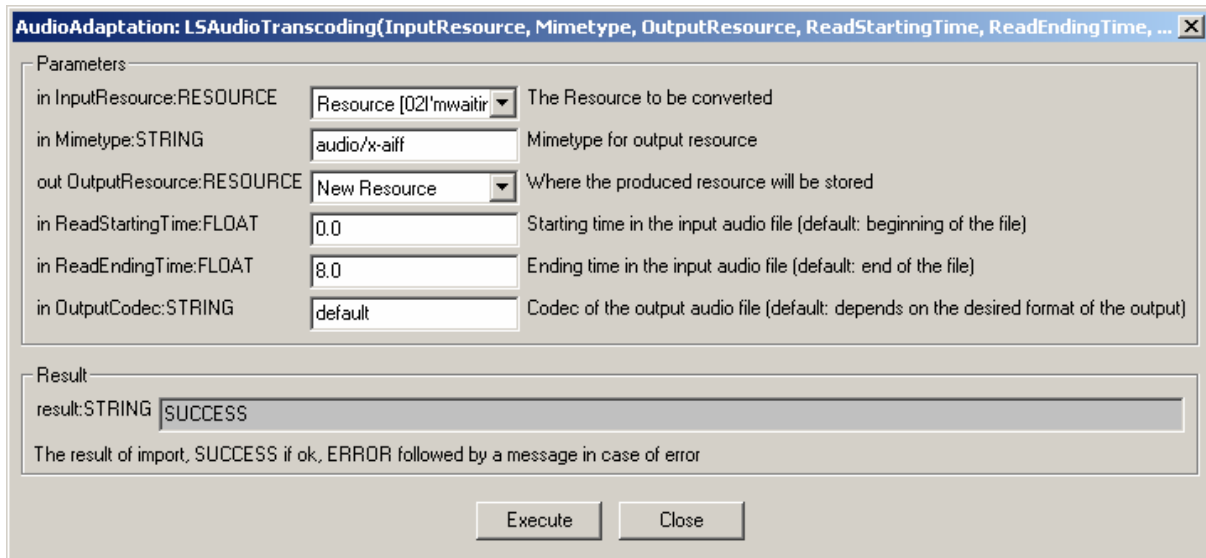


The first audio adaptation function available is the libsndfile transcoding function which is selected by clicking on **LSAudioAdaptation: LSAudioTranscoding**. A new window appears showing the interface to

the audio transcoding function. In the example of the following figure, the transcoding function is used to create a 10 second snapshot with reduced bit rate of the input audio file:

- AIFF format
- Only a portion of 8 seconds of the input resource is selected (just the beginning of the sound track)

Such a snapshot could be useful for small audio sampling.



#### Major Features accessible:

- Audio transcoding with FFMEPG library
- Audio transcoding with Libsndfile library

## 4.4 Image Adaptation (DSI)

Image adaptation tools provide functions which can be used for scaling, resolution improvements, text drawing, and image decomposition etc. of an image file. In the case of Image Objects, the following libraries can be used for implementing the functions described above.

#### ImageMagick Library

ImageMagick, version 6.2.3, is a free software suite designed to create, edit, and compose bitmap images. It can read, convert and write images in a large variety of formats. Images can be cropped, colors can be changed, various effects can be applied; images can be rotated and combined, and text, lines, polygons, ellipses and Bezier curves can be added to images and stretched and rotated.

Here are just a few examples of what ImageMagick can do:

- Convert an image from one format to another (e.g. PNG to JPEG)
- Resize, rotate, sharpen, colour reduce, or add special effects to an image

- iii. Create a montage of image thumbnails
- iv. Create a transparent image suitable for use on the Web
- v. Turn a group of images into a GIF animation sequence
- vi. Create a composite image by combining several images
- vii. Draw shapes or text on an image
- viii. Decorate an image with a border or frame
- ix. Describe the format and characteristics of an image

**Major Features accessible:**

A list of supported formats is given below. The documentation of the ImageMagick is available on <http://www.imagemagick.org/>.

Tag	Mode	Description	Notes
ART	R	PFS: 1st Publisher	Format originally used on the Macintosh (MacPaint?) and later used for PFS: 1st Publisher clip art.
AVI	R	Microsoft Audio/Visual Interleaved	
AVS [44]	RW	AVS X image	
BMP[45]	RW	Microsoft Windows bitmap	
CGM	R	Computer Graphics Metafile	Requires ralcgm to render CGM files.
CIN	RW	Kodak Cineon Image Format	Cineon Image Format is a subset of SMTPE DPX.
CMYK	RW	Raw cyan, magenta, yellow, and black samples	Set <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
CMYKA	RW	Raw cyan, magenta, yellow, black, and alpha samples	Set <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
CUR	R	Microsoft Cursor Icon	
CUT	R	DR Halo	
DCM	R	Digital Imaging and Communications in Medicine (DICOM) image	Used by the medical community for images like X-rays.
DCX	RW	ZSoft IBM PC multi-page Paintbrush image	
DIB	RW	Microsoft Windows Device Independent Bitmap	DIB is a BMP file without the BMP header. Used to support embedded images in compound formats like WMF.
DPX	RW	Digital Moving Picture Exchange	
EMF	R	Microsoft Enhanced Metafile (32-bit)	Only available under Microsoft Windows.
EPDF	RW	Encapsulated Portable Document Format	
EPI	RW	Adobe Encapsulated	Requires Ghostscript to read.

Tag	Mode	Description	Notes
		PostScript Interchange format	
EPS	RW	Adobe Encapsulated PostScript	Requires Ghostscript to read.
EPS2	W	Adobe Level II Encapsulated PostScript	Requires Ghostscript to read.
EPS3	W	Adobe Level III Encapsulated PostScript	Requires Ghostscript to read.
EPSF	RW	Adobe Encapsulated PostScript	Requires Ghostscript to read.
EPSI	RW	Adobe Encapsulated PostScript Interchange format	Requires Ghostscript to read.
EPT	RW	Adobe Encapsulated PostScript Interchange format with TIFF preview	Requires Ghostscript to read.
FAX	RW	Group 3 TIFF	See TIFF format. Note that FAX machines use non-square pixels which are 1.5 times wider than they are tall but computer displays use square pixels so FAX images may appear to be narrow unless they are explicitly resized using a resize specification of "150x100%".
FIG	R	FIG graphics format	Requires TransFig.
FITS	RW	Flexible Image Transport System	
FPX	RW	FlashPix Format	Requires FlashPix SDK.
GIF	RW	CompuServe Graphics Interchange Format	8-bit RGB PseudoColor with up to 256 palette entries. Specify the format "GIF87" to write the older version 87a of the format.
GPLT	R	Gnuplot plot files	Requires gnuplot3.5.tar.Z or later.
GRAY	RW	Raw gray samples	Use -size and -depth to specify the image width, height, and depth.
HPGL	R	HP-GL plotter language	Requires hp2xx-3.2.0.tar.gz
HTML	RW	Hypertext Markup Language with a client-side image map	Also known as "HTM". Requires html2ps to read.
ICO	R	Microsoft icon	Also known as "ICON".
JBIG	RW	Joint Bi-level Image experts Group file interchange format	Also known as "BIE" and "JBG". Requires jbigkit-1.0.tar.gz.
JNG	RW	Multiple-image Network Graphics	JPEG in a PNG-style wrapper with transparency. Requires libjpeg and libpng-1.0.2 or later, libpng-1.2.5 or later recommended.
JP2	RW	JPEG-2000 JP2 File Format Syntax	Requires jasper-1.600.0.zip
JPC	RW	JPEG-2000 Code Stream Syntax	Requires jasper-1.600.0.zip
JPEG	RW	Joint Photographic	Requires jpegsrc.v6b.tar.gz

Tag	Mode	Description	Notes
		Experts Group JFIF format	
MAN	R	Unix reference manual pages	Requires that GNU groff and Ghostscript are installed.
MAT	R	MATLAB image format	
MIFF	RW	Magick image file format	Open ImageMagick's own image format (with ASCII header) which ensures that no image attributes understood by ImageMagick are lost.
MONO	RW	Bi-level bitmap in least-significant-byte first order	
MNG	RW	Multiple-image Network Graphics	A PNG-like Image Format Supporting Multiple Images, Animation and Transparent JPEG. Requires libpng-1.0.2 or later, libpng-1.2.5 or later recommended.
MPEG	RW	Motion Picture Experts Group file interchange format (version 1)	Requires mpeg2vidcodec v12.tar.gz.
M2V	RW	Motion Picture Experts Group file interchange format (version 2)	Requires mpeg2vidcodec v12.tar.gz.
MPC	RW	Magick Persistent Cache image file format	The native "in-memory" ImageMagick uncompressed file format. This file format is identical to that used by Open ImageMagick to represent images in memory and is read in "zero time" via memory mapping. The MPC format is not portable and is not suitable as an archive format. It is suitable as an intermediate format for high-performance image processing. The MPC format requires two files to support one image. When writing the MPC format, a file with extension ".mpc" is used to store information about the image, while a file with extension ".cache" stores the image pixels. The storage space required by a MPC image (or an image in memory) may be calculated by the equation $(5 * \text{QuantumDepth} * \text{Rows} * \text{Columns}) / 8$ .
MSL	RW	Magick Scripting Language	MSL is the XML-based scripting language supported by the conjure utility.
MTV	RW	MTV Raytracing image format	
MVG	RW	Magick Vector Graphics.	The native ImageMagick vector metafile format. A text file containing vector drawing commands accepted by convert's -draw option.
OTB	RW	On-the-air Bitmap	

Tag	Mode	Description	Notes
P7	RW	Xv's Visual Schnauzer thumbnail format	
PALM	RW	Palm pixmap	
PBM	RW	Portable bitmap format (black and white)	
PCD	RW	Photo CD	The maximum resolution written is 768x512 pixels since larger images require huffman compression (which is not supported).
PCDS	RW	Photo CD	Decode with the sRGB color tables.
PCL	W	HP Page Control Language	For output to HP laser printers.
PCX	RW	ZSoft IBM PC Paintbrush file	
PDB	RW	Palm Database ImageViewer Format	
PDF	RW	Portable Document Format	Requires Ghostscript to read.
PFA	R	Postscript Type 1 font (ASCII)	Opening as file returns a preview image.
PFB	R	Postscript Type 1 font (binary)	Opening as file returns a preview image.
PGM	RW	Portable graymap format (gray scale)	
PICON	RW	Personal Icon	
PICT	RW	Apple Macintosh QuickDraw/PICT file	
PIX	R	Alias/Wavefront RLE image format	
PNG	RW	Portable Network Graphics	Requires libpng-1.0.2 or later, libpng-1.2.5 or later recommended.
PNM	RW	Portable anymap	PNM is a family of formats supporting portable bitmaps (PBM) , graymaps (PGM), and pixmaps (PPM). There is no file format associated with pnm itself. If PNM is used as the output format specifier, then ImageMagick automatically selects the most appropriate format to represent the image. The default is to write the binary version of the formats. Use +compress to write the ASCII version of the formats.
PPM	RW	Portable pixmap format (color)	
PS	RW	Adobe PostScript file	Requires Ghostscript to read.
PS2	RW	Adobe Level II PostScript file	Requires Ghostscript to read.
PS3	RW	Adobe Level III PostScript file	Requires Ghostscript to read.
PSD	RW	Adobe Photoshop bitmap file	
PTIF	RW	Pyramid encoded	Multi-resolution TIFF containing



Tag	Mode	Description	Notes
		TIFF	successively smaller versions of the image down to the size of an icon. The desired sub-image size may be specified when reading via the <code>-size</code> option.
PWP	R	Seattle File Works multi-image file	
RAD	R	Radiance image file	Requires that <code>ra_ppm</code> from the Radiance software package be installed.
RGB	RW	Raw red, green, and blue samples	Use <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
RGBA	RW	Raw red, green, blue, and alpha samples	Use <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
RLA	R	Alias/Wavefront image file	
RLE	R	Utah Run length encoded image file	
SCT	R	Scitex Continuous Tone Picture	
SFW	R	Seattle File Works image	
SGI	RW	Irix RGB image	
SHTML	W	Hypertext Markup Language client-side image map	Used to write HTML clickable image maps based on a the output of montage or a format which supports tiled images such as MIFF.
SUN	RW	SUN Rasterfile	
SVG	RW	Scalable Vector Graphics	Requires libxml2 and freetype-2. Note that SVG is a very complex specification so support is still not complete.
TGA	RW	Truevision Targa image	Also known as formats "ICB", "VDA", and "VST".
TIFF	RW	Tagged Image File Format	Also known as "TIF". Requires tiff-v3.6.1.tar.gz or later. Note that since Unisys claims a patent on the LZW algorithm (expiring in the US as of June 2003) used by LZW-compressed TIFF files, ImageMagick binary distributions do not include support for the LZW algorithm so LZW TIFF files can not be written. Although a patch is available for libtiff to enable building with LZW support. Users should consult the Unisys LZW web page before applying it.
TIM	R	PSX TIM file	
TTF	R	TrueType font file	Requires freetype 2. Opening as file returns a preview image.
TXT	RW	Raw text file	
UIL	W	X-Motif UIL table	
UYVY	RW	Interleaved YUV raw image	Use <code>-size</code> command line option to specify width and height.
VICAR	RW	VICAR rasterfile	

Tag	Mode	Description	Notes
		format	
VIFF	RW	Khoros Visualization Image File Format	
WBMP	RW	Wireless bitmap	Support for uncompressed monochrome only.
WMF	R	Windows Metafile	Requires libwmf. By default, renders WMF files using the dimensions specified by the metafile header. Use the <code>-density</code> option to adjust the output resolution, and thereby adjust the output size. The default output resolution is 72DPI so <code>"-density 144"</code> results in an image twice as large as the default. Use <b>-background color</b> to specify the WMF background color (default white) or <b>-texture filename</b> to specify a background texture image.
WPG	R	Word Perfect Graphics File	
XBM	RW	X Windows system bitmap, black and white only	Used by the X Windows System to store monochrome icons.
XCF	R	GIMP image	
XPM	RW	X Windows system pixmap	Also known as "PM". Used by the X Windows System to store color icons.
XWD	RW	X Windows system window dump	Used by the X Windows System to save/display screen dumps.
YCbCr	RW	Raw Y, Cb, and Cr samples	Use <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
YCbCrA	RW	Raw Y, Cb, Cr, and alpha samples	Use <code>-size</code> and <code>-depth</code> to specify the image width, height, and depth.
YUV	RW	CCIR 601 4:1:1	

## 4.5 Document Adaptation (DIPITA)

The following conversion libraries are the ones that will be used for text document conversion, as they obtain (according to the literature) the best performances compared to the other similar ones:

**1. DOCFRAC** (<http://docfrac.sourceforge.net/>), that allows conversions from RTF to HTML, from RTF to TXT, from HTML to RTF, from HTML to TXT, from TXT to RTF and from TXT to HTML.

The exploitation of the DOCFRAC features library will be particularly useful for converting active web pages, converting many documents at a time and converting output from Microsoft's Internet Explorer RTF control to HTML.

The supported platforms are Windows, Linux (command line) and programming kit (ActiveX and DLL). DocFrac is free. It is released under the [LGPL](#).

**2. GNU Ghostscript** (<http://www.cs.wisc.edu/~ghost/>)

Ghostscript is the name of a set of software that contains an interpreter for the PostScript (TM) language and the Adobe Portable Document Format, and a set of C procedures (the Ghostscript library) that implement the graphics and filtering (data compression / decompression / conversion) capabilities that appear as primitive

operations in the PostScript language and in PDF. Versions entitled "GNU Ghostscript" are distributed with the GNU General Public License.

### 3. XPDF (<http://www.foolabs.com/xpdf/>)

Xpdf is an open source viewer for Portable Document Format (PDF) files. The Xpdf project also includes a PDF text extractor, PDF-to-PostScript converter, and various other utilities.

Xpdf runs under the X Window System on UNIX, VMS, and OS/2. The non-X components (pdftops, pdftotext, etc.) also run on Win32 systems and should run on pretty much any system with a decent C++ compiler.

Xpdf is designed to be small and efficient. It can use Type 1, TrueType, or standard X fonts.

Xpdf is licensed under the GNU General Public License (GPL), version 2.

### 4. HTMLDOC (<http://www.easysw.com/htmldoc/>)

HTMLDOC converts HTML source files into indexed HTML, PostScript, or Portable Document Format (PDF) files that can be viewed online or printed.

The program is free software and is distributed under GPL.

### 5. PDF2HTML (<http://pdftohtml.sourceforge.net/>)

pdftohtml is a utility which converts PDF files into HTML and XML formats. It's based on the xpdf 2.02 by Derek Noonburg.

The program is free software and is distributed under GPL.

### 6. a2ps (<http://gnuwin32.sourceforge.net/packages/a2ps.htm>)

GNU a2ps is an Any to PostScript filter. Of course it processes plain text files, but also pretty prints quite a few popular languages. Its slogan is precisely "Do The Right Thing", which means that though it is highly configurable, everything was made so that a novice user can do complicated PostScript manipulations. For instance, it has the ability to delegate the processing of some files to other filters (such as groff, texi2dvi, dvips, gzip etc.), what allows a uniform treatment (n-up, page selection, duplex etc.) of heterogeneous files. It supports a wide number of encodings, and a very good handling of Latin 2-6 should be noted, thanks to Ogonkify (by Juliusz Chroboczek). Needed fonts are automatically downloaded. The interface is internationalized, the output is customizable and there are as many options as users had wishes (table of content, headings, virtual page layout etc. etc.).

The program is free software and is distributed under GPL.

To test the first results of the adaptation tool, it has been created a test corpus for content adaptation. It contains several documents, each one in different textual format, and precisely:

- a) Digital music report 2005 (a state of the art on digital music; formats: pdf, txt)
- b) European constitution (the EU constitution in Italian, formats: pdf, rtf, txt)
- c) Hibernate documentation (documentation on an object/relational mapping tool for Java environments; formats: pdf, html, txt)
- d) Html specification (specification from the w3c on html formatting; formats: pdf, ps, html, txt).

## 4.6 Video Adaptation (FHGIGD)

The work performed focused on the (integration of) transcoding algorithms. To show AXMEDIS' capabilities in terms of content adaptation as well as extensibility the FFMPEG library has been selected for the implementation/integration of the firstly available video adaptation functionality.

The via command line version of FFMPEG available video options are:

-b bitrate	set video bitrate (in kbit/s)
-r rate	set frame rate (Hz value, fraction or abbreviation)
-s size	set frame size (WxH or abbreviation)
-aspect aspect	set aspect ratio (4:3, 16:9 or 1.3333, 1.7777)
-croptop size	set top crop band size (in pixels)
-cropbottom size	set bottom crop band size (in pixels)
-cropleft size	set left crop band size (in pixels)
-cropright size	set right crop band size (in pixels)
-vn	disable video
-bt tolerance	set video bitrate tolerance (in kbit/s)
-maxrate bitrate	set max video bitrate tolerance (in kbit/s)
-minrate bitrate	set min video bitrate tolerance (in kbit/s)
-bufsize size	set ratecontrol buffere size (in kByte)
-vcodec codec	force video codec ('copy' to copy stream)
-sameq	use same video quality as source (implies VBR)
-pass n	select the pass number (1 or 2)
-passlogfile file	select two pass log file name

Besides the basic functionality so called “advanced options” are available:

-pix_fmt format	set pixel format
-g gop_size	set the group of picture size
-intra	use only intra frames
-qscale q	use fixed video quantiser scale (VBR)
-qmin q	min video quantiser scale (VBR)
-qmax q	max video quantiser scale (VBR)
-mbqmin q	min macroblock quantiser scale (VBR)
-mbqmax q	max macroblock quantiser scale (VBR)
-qdiff q	max difference between the quantiser scale (VBR)
-qblur blur	video quantiser scale blur (VBR)
-qcomp compression	video quantiser scale compression (VBR)
-rc_init_cplx	complexity initial complexity for 1-pass encoding
-b_qfactor factor	qp factor between p and b frames
-i_qfactor factor	qp factor between p and i frames
-b_qoffset offset	qp offset between p and b frames
-i_qoffset offset	qp offset between p and i frames
-rc_eq equation	set rate control equation
-rc_override	override rate control override for specific intervals
-me method	set motion estimation method
-dct_algo algo	set dct algo
-idct_algo algo	set idct algo
-er n	set error resilience
-ec bit_mask	set error concealment
-bf frames	use 'frames' B frames
-mbd mode	macroblock decision
-mbcmp	cmp function macroblock compare function
-ildctcmp	cmp function ildct compare function
-subcmp	cmp function subpel compare function
-cmp	cmp function fullpel compare function
-4mv	use four motion vector by macroblock (MPEG4)
-obmc	use overlapped block motion compensation (h263+)
-part	use data partitioning (MPEG4)
-bug param	workaround not auto detected encoder bugs
-strict strictness	how strictly to follow the standarts

-deinterlace	deinterlace pictures
-ildct	force interlaced dct support in encoder (MPEG2/MPEG4)
-ilme	force interlaced me support in encoder MPEG2
-psnr	calculate PSNR of compressed frames
-vstats	dump video coding statistics to file
-vhook module	insert video processing module
-aic	enable Advanced intra coding (h263+)
-aiv	enable Alternative inter vlc (h263+)
-umv	enable Unlimited Motion Vector (h263+)
-alt	enable alternate scantable (mpeg2)
-trell	enable trellis quantization
-scan_offset	enable SVCD Scan Offset placeholder
-intra_matrix	matrix specify intra matrix coeffs
-inter_matrix	matrix specify inter matrix coeffs
-top	top=1/bottom=0/auto=-1 field first
-nr	noise reduction

The functionality available within FFMPEG addresses two categories of video adaptation:

- Considering the (fixed) needs of the content creator or service providers: The content can be adapted according to the requirements of the content creator or service providers. The simplest case is the adaptation of the spatial resolution as supported by FFMPEG to a fixed resolution without changing the aspect ratio.
- Dynamic content creation: FFMPEG also allows changing the aspect ratio of the video content. Thus, a basic functionality required to dynamically adapt content according to the receiving device is available.

#### 4.6.1 Video-Adaptation plug-in

Current version of the video adaptation plug-in implements a sub-set of the potential parameters as shown in the next diagram respectively as described below:

Parameters		
in InputResource:RESOURCE	Resource [gromit.mpg]	The Resource to be converted
in Mimetype:STRING	avi	Mimetype for output resource
out OutputResource:RESOURCE	New Resource	Where the produced resource will be stored
in OutputAudioSamplingRate:UINT32	0	Sampling rate of the output audio file (default: sampling rate of the input)
in OutputAudioNumChannels:UINT16	0	Number of channels of the output audio file (default: number of channels of the input)
in OutputAudioBitRate:UINT16	0	Bit rate of the output audio file in kB (default: bitrate of the input)
in OutputAudioCodec:STRING	default	Codec of the output audio file (default: codec of the output, also possible "copy")
in OutputVideoWidth:UINT16	0	Width of the output video file (default: width of the input)
in OutputVideoHeight:UINT16	0	Height of the output video file (default: height of the input)
in OutputVideoBitRate:UINT16	0	Bit rate of the output video file in kB (default: bitrate of the input)
in OutputVideoCodec:STRING	default	Codec of the output video file (default: codec of the output, also possible "copy")

Result	
result:STRING	
The result of import, SUCCESS if ok, ERROR followed by a message in case of error	

- AudioSamplingRate: Sampling rate of the output audio.
- AudioNumChannels: Number of Channels of the output audio file.
- AudioBitRate: Bit rate of the output audio file in kB.
- AudioCodec: Codec of the output audio file.
- VideoWidth; Width of the output video file.
- VideoHeight: Height of the output video file.
- VideoBitRate: Bit rate of the output video file in kB.
- VideoCodec: Codec of the output video file.

#### 4.7 Future Work in Digital Item Adaptation (UR, DSI, DIPITA, EPFL, FHGIGD)

Re AXDMA , the future work could involve enriching the existing classes with additional functionalities for enhanced dynamic management of profiles.

Re AXTRANS, the future work could conduct extensive testing of the modules integratively within the AXMEDIS Framework and implement responsive necessary refinements in the light of the user feedback.

Testing can be carried out at two phases. The first phase can take place within the laboratory whereby the plugin can be tested extensively to cover various user scenarios. The second phase can include testing to be carried out by other partners and users. Another task could be to seek to integrate a library other than Timidity so as to provide the MIDI support to the Ringtone Adaptation Module.within AXTRANS.

## 5 Work Done in DRM Support for Mobile and Interoperability (FUPF)

Different systems define different rights expression languages. If it is desired to make heterogeneous systems interoperable we may have to adapt the rights expressions.

Moreover, changing versions of the specifications could make it difficult to implement any kind of software to resolve the interoperability challenges.

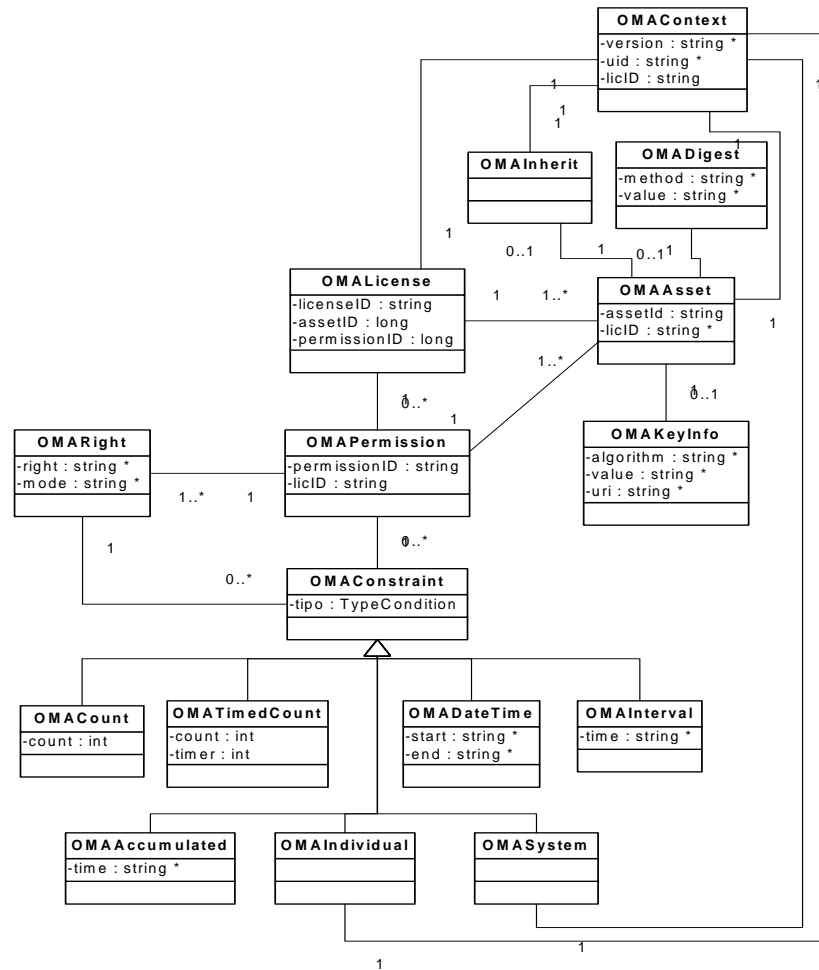
Not only different systems and versions are problematic re DRM interoperability, but also, the devices present in the mobile environment involve different ways of programming. For instance, some PDAs supporting mobile communication use Windows based systems, while other kind of mobile phones, use systems based on Symbian or other systems. The implementation of a software system as a generic solution to support rights expression languages for such a heterogeneous environments is thus a challenging task.

### 5.1 Implementation and Results

In order to be able to transform rights expressions expressed from language to language, the first step to take is to study their common points. We have studied in detail the relationship between MPEG-21 REL and ODRL, based on the OMA DRM REL, as follows

#### 5.1.1 Definition of UML and relational models for OMA DRM REL

We have defined two different models, a relational model and a UML model for describing OMA DRM licenses. The aim of this definition is to cover all the possibilities that can be expressed by the language in order to facilitate its processing. Figure 2 below shows the UML class diagram, as implemented, representing the OMA licenses.



**Figure 6.1: OMA DRM REL UML Class Diagram**

Each OMALicense is defined by a licenseID, that is a unique identifier for it, an OMAContext element, that expresses the uid and the version of the standard that has been used to create the license, and, two more vectors containing the OMAAssets and OMAPermissions.

Unlike that which pertains to MPEG-21, the OMAAssets (resources) and the OMAPermissions (constraints and rights) are stored separately because that is the way the license tend to represent them.

The OMAAsset stores all the information about the OMAContext (the real name and its version), the OMADigest (created at the end if the license is to be signed), the OMAInherit information (if the license is derived from another one), and the OMAKey Information, which is represented by an algorithm and a value.

The OMAPermission associates one or more assets with one or more rights. The OMAPermission can have a set of constraints that applies to all the rights, and each right can also have a set of constraints that only affects itself.

We have also defined all the OMAConstraints that can be represent with that Right Expression Language as Count, Timed Count, Date Time, Interval, Accumulated, Individual and System.

We are currently representing licenses that follow the version 2.0 of the OMA standard [30].



The design of the ER structure representing the relational model has been based in the multiplicity of the elements involving OMA DRM REL licenses, specially the assets and the permissions.

Figure 3 below represents the structure that defines our solution for storing OMA DRM licenses in a scalable and efficient way.

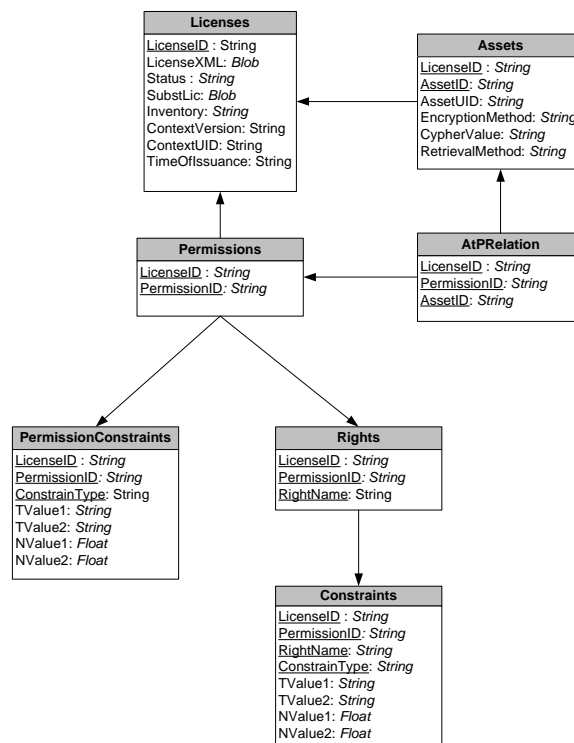
As in the UML model representation, we have separated the assets and the permissions in two different tables, as they do not have a 1 – 1 multiplicity. Accordingly an extra table has to be introduced to store the relation between the elements.

For each asset we store only the values that are useful to perform the authorisation process. They involve Context and the Key Information.

If the permission has a specific right, we store it in two different tables, as happens in the static model.

The first table contains the rights information, and the second one is to store the constraints values. In some cases, we only need to store the constraint type and its values in a separated table.

With this ER structure, we are able to store all the different ways in which licenses can be defined, and make it easier to perform the authentication and expand the model as the standard develops in the future.



**Figure 6.2: OMA DRM REL ER Diagram**

## 5.2 Future Work in DRM Support for Mobile and Interoperability (FUPF)

The future work could involve examining the implemented classes for any representation and interoperability gaps. This would involve extensive testing of the modules integrated within AXMEDIS and implementing responsive necessary refinements in the light of the user feedback.

## 6 Work Done on Supporting Interoperability between MPEG-21 and OMA (DSI)

Details regarding this part are included into Annex 1 to this document.

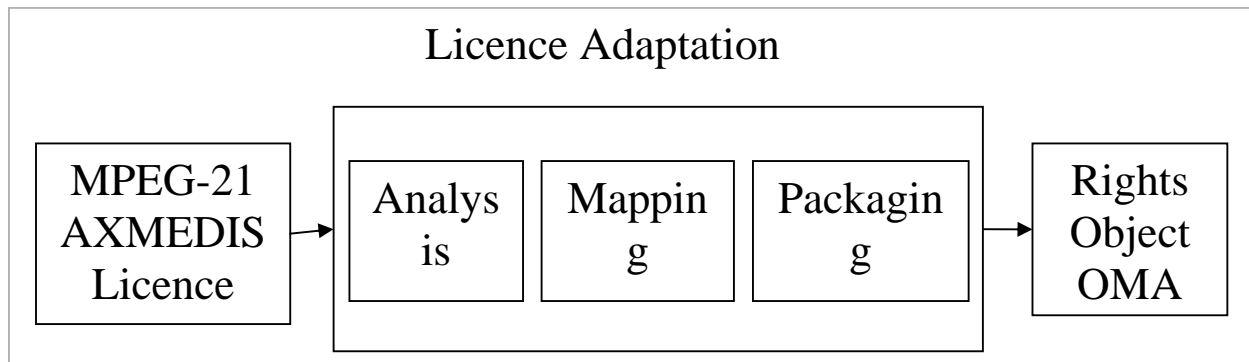
The Annex I is a document in Italian language that presents an experiment in which the AXMEDIS Content processing platform has been used to prove the interoperability and multichannel management among AXMEDIS based channel (MPEG-21) and OMA channel.

For this purpose the AXMEDIS java script of AXCP has been used as a back end for:

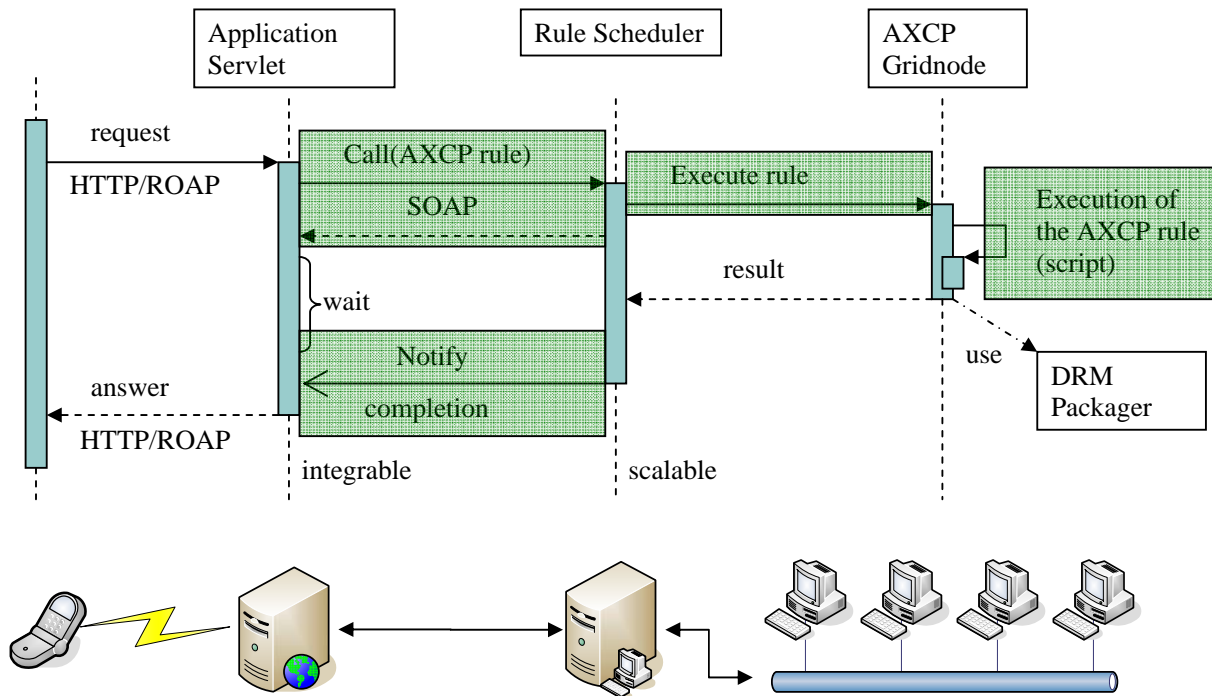
- Licence transformation (similarly to what has been described by FUPF in the previous chapter)
- Adaptation of content
- Access to AXMEDIS content and resources in general
- Production of OMA packages by means of the SonyEricsson OMA packager
- Production of ODRL OMA licenses
- Posting of OMA packages to an OMA like distribution server
- Posting of OMA ODRL license to an OMA like distribution server

A front end OMA like distribution server has been realised providing:

- The OMA protocol for communicating with clients



## 6.1 Protocol description



## 6.2 AXMEDIS CP GRID Script: ISSUE.XML RULE

```

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="Rule_Axmedis.xsd">
  <Header>
    <Rule_Name>issue</Rule_Name>
    <AXRID>axcprule:5e0215fc-501a-422f-ace3-959326da62b7</AXRID>
    <Rule_Version />
    <Rule_Type>AXCP</Rule_Type>
    <Software_Name />
    <Version_of_software />
    <Date_of_production>2006-08-17</Date_of_production>
    <Author />
    <Affiliation />
    <URL />
    <Comment />
    <Last_Modifications>2006-08-18</Last_Modifications>
    <Terminal_ID />
    <Cost />
    <Work_Item_ID />
  </Header>
  <Schedule>
  <Run>

```

```

<Date>2006-08-17</Date>
<Time>01:02:38</Time>
<Periodicity Unit="Day">0</Periodicity>
<Expiration_Date>2006-08-17</Expiration_Date>
<Expiration_Time>01:02:38</Expiration_Time>
</Run>
<Status>Inactive</Status>
</Schedule>
- <Definition>
- <AXCP_Rule>
- <Arguments>
  <Parameter Name="axoid" Type="String" />
  <Parameter Name="user" Type="String" />
  <Parameter Name="uriRights" Type="String" />
  <Parameter Name="uriContents" Type="String" />
  <Parameter Name="uriResources" Type="String" />
  <Parameter Name="uriLicenses" Type="String" />
  <Parameter Name="uriPackager" Type="String" />
  </Arguments>
- <Rule_Body>
  - <JS_Script name="main">
    - <![CDATA[
function sample(){
  if (authenticate()){
    var axobject = getObject();
    if(axobject != null){
      var axresource = getResource(axobj);
      if(axresource != null){
        var resourceURI = uriResources + axresource.contentID;
        axresource.save(resourceURI);

        var licenseURI = getLicenseURI();
        if(licenseURI != null){
          var omaobject = parseLicense(licenseURI);
          var i = 0;
          for(i in omaobject.resources){
            var resource = omaobject.resources[i];
            if(resource.ID == axresource.contentID){
              packageResource(resource, axresource.mimeType);
            }
          }
        }
      }
    }
  }
}
]]>
  </JS_Script>
- <JS_Script name="authentication">
  - <![CDATA[
// override this for validating users.
// function reads user ID from global parameter 'user'.
function authenticate(){
  if(user != ""){
    return true;

```

```

    }else{
        return false;
    }
}
]]>
</JS_Script>
=<JS_Script name="axmedis">
- <![CDATA[
// override this to search and return an AxObject by AXOID, null otherwise.
// function reads AXOID from global parameter 'axoid'.
function getObject(){
    return null;
}
// extract the resource in an AxObject.
// assume that there is just one resource in each object.
function getResource(axobj){
    var contents = obj.getContent();

    if(contents != null && contents.length > 0){
        var content = contents[0];
        if(content instanceof AxResource){
            return content;
        }
    }

    return null;
}
]]>
</JS_Script>
=<JS_Script name="oma">
- <![CDATA[
function omaObject(){
    this.issuer = null;
    this.resources = new Array();
    this.print = omaprint;
}
function omaResource(){
    this.ID = null;
    this.right = null;
    this.count = null;
    this.from = null;
    this.to = null;
    this.principal = null;//redundant
    this.print = resourceprint;
}
function omaprint(){
    print("issuer: " + this.issuer);

    var i = 0;
    for(i in this.resources){
        this.resources[i].print();
    }
}

```

```

    }
}
function resourceprint(){
    print("ID: " + this.ID);
    print("  right: " + this.right);
    print("  count: " + this.count);
    print("  from: " + this.from);
    print("  to: " + this.to);
    print("  principal: " + this.principal);
}
]]>
</JS_Script>
=<JS_Script name="license">
- <![CDATA[
var omaobj;
// override this to return the user's license file path.
function getLicenseURI(){
    var licenseURI = uriLicenses + user + ".xml";
    if(existFile(licenseURI)){
        return licenseURI;
    }else{
        return null;
    }
}
// parse an AxLicense stored in an XML file.
// return an 'oma' object filled with the information retrieved from license.
function parseLicense(licenseURI){
    var xml = readFromFile(licenseURI);
    var xmldoc = new REXML(xml);

    omaobj = new omaObject();
    visit(xmldoc.rootElement);

    return omaobj;
}
function visit(element){
    switch(element.name){
        case "r:issuer":
            omaobj.issuer = resolveIssuer(element);
            break;
        case "mx:diReference":
            omaobj.resources[omaobj.resources.length] = resolveResource(element);
            break;
    }
}

var i = 0;
for(i in element.childElements){
    var current = element.childElements[i];
    if(current.type == "element")
        visit(current);

```

```

    }
}
function resolveResource(element){
    var res = new omaResource();

    // ID
    res.ID = resolveID(element);

    // properties
    i = 0;
    var parent = element.parentElement;
    for(i in parent.childElements){
        current = parent.childElements[i];
        switch(current.name){
            case "r:keyHolder":
                res.principal = resolvePrincipal(current);
                break;
            case "r:allConditions":
                var conditions = resolveConditions(current);
                res.count = conditions.count;
                res.from = conditions.from;
                res.to = conditions.to;
                break;
            case "mx:play":
            case "mx:print":
            case "mx:execute":
                res.right = current.name;
                break;
        }
    }
}

return res;
}
function resolveIssuer(element){
    var keyholder = element.childElement("r:keyHolder");
    var info = keyholder.childElement("r:info");
    var keyname = info.childElement("dsig:KeyName");
    return keyname.text;
}
function resolveID(element){
    var identifier = element.childElement("mx:identifier");
    return identifier.text;
}
function resolvePrincipal(element){
    var info = element.childElement("r:info");
    var keyname = info.childElement("dsig:keyName");
    return keyname.text;
}
function resolveConditions(element){

```

```

var conditions = new Object();

conditions.count = null;
conditions.from = null;
conditions.to = null;

var i = 0;
for(i in element.childElements){
    var current = element.childElements[i];
    switch(current.name){
        case "sx:exerciseLimit":
            var count = current.childElement("sx:count");
            conditions.count = count.text;
            break;
        case "r:validityInterval":
            var from = current.childElement("r:notBefore");
            var to = current.childElement("r:notAfter");
            conditions.from = from.text;
            conditions.to = to.text;
            break;
    }
}

return conditions;
}
]]>
</JS_Script>
- <JS_Script name="jspxml">
- <![CDATA[
////////////////////
////////// JSXML XML Tools          //////////
////////// Ver 1.2 Jun 18 2001      //////////
////////// Copyright 2000 Peter Tracey  //////////
////////// http://jspxml.homestead.com/  //////////
////
//// Objects:
////
//// REXML
//// Regular Expression-based XML parser
////
//// JSXMLElement
//// Iterates through the tree structure without recursion
////
//// JSXMLElementBuilder
//// Loads xml into a linear structure and provides
//// interface for adding and removing elements
//// and setting attributes, generates XML
////
//// Utility functions:
////

```



```

//// ParseAttribute
//// Takes string of attributes and attribute name
//// Returns attribute value
////
//// Array_Remove
//// Removes element in array
////
//// Array_Add
//// Adds element to array
////
//// RepeatChar
//// Repeats string specified number of times
////
////////////////////////////////////
function REXML(XML) {
    this.XML = XML;
    this.rootElement = null;
    this.parse = REXML_parse;
    if (this.XML && this.XML != "") this.parse();
}

function REXML_parse() {
    var reTag = new RegExp("<([> / ]*)([>]*)>", "g"); // matches that tag name $1 and attribute string $2
    var reTagText = new RegExp("<([> / ]*)([>]*)>([<]*)", "g"); // matches tag name $1, attribute string $2, and text $3
    var strType = "";
    var strTag = "";
    var strText = "";
    var strAttributes = "";
    var strOpen = "";
    var strClose = "";
    var iElements = 0;
    var xmleLastElement = null;
    if (this.XML.length == 0) return;
    var arrElementsUnparsed = this.XML.match(reTag);
    var arrElementsUnparsedText = this.XML.match(reTagText);
    var i=0;
    if (arrElementsUnparsed[0].replace(reTag, "$1") == "?xml") i++;
    for (; i<arrElementsUnparsed.length; i++) {
        strTag = arrElementsUnparsed[i].replace(reTag, "$1");
        strAttributes = arrElementsUnparsed[i].replace(reTag, "$2");
        strText = arrElementsUnparsedText[i].replace(reTagText, "$3").replace(/[ \r\n\t ]+/g, " "); // remove white space
        strClose = "";
        if (strTag.indexOf("[CDATA[") == 0) {
            strOpen = "<![CDATA[";
            strClose = "";
            strType = "cdata";
        } else if (strTag.indexOf("!--") == 0) {
            strOpen = "<!--";
            strClose = "-->";
            strType = "comment";
        }
    }
}

```

```

    } else if (strTag.indexOf("?") == 0) {
        strOpen = "<?";
        strClose = ">";
        strType = "pi";
    } else strType = "element";
    if (strClose != "" && strType!="comment") { // added by Ivan Bruno
        strText = "";
        if (arrElementsUnparsedText[i].indexOf(strClose) > -1) strText = arrElementsUnparsedText[i];
        else {
            for (; i<arrElementsUnparsed.length &&
arrElementsUnparsedText[i].indexOf(strClose) == -1; i++) {
                strText += arrElementsUnparsedText[i];
            }
            strText += arrElementsUnparsedText[i];
        }
        if (strText.substring(strOpen.length, strText.indexOf(strClose)) != "") {
            xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element(strType, "", "", xmleLastElement, strText.substring(strOpen.length, strText.indexOf(strClose)));
            if (strType == "cdata") xmleLastElement.text += strText.substring(strOpen.length,
strText.indexOf(strClose));
        }
        if (strText.indexOf(strClose)+ strClose.length < strText.length) {
            xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText.substring(strText.indexOf(strClose)+ strClose.length, strText.length));
            if (strType == "cdata") xmleLastElement.text +=
strText.substring(strText.indexOf(strClose)+ strClose.length, strText.length);
        }
        continue;
    }
    if (strText.replace(/ */, "") == "") strText = "";
    if (arrElementsUnparsed[i].substring(1,2) != "/") {
        if (iElements == 0) {
            xmleLastElement = this.rootElement = new REXML_XML_Element(strType,
strTag, strAttributes, null, strText);

            iElements++;
            if (strText != "")
xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
"", "", xmleLastElement, strText);
        } else if (arrElementsUnparsed[i].substring(arrElementsUnparsed[i].length-
2, arrElementsUnparsed[i].length-1) != "/") {
            xmleLastElement =
xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element(strType,
strTag, strAttributes, xmleLastElement, "");
            iElements++;
            if (strText != "") {
                xmleLastElement.text += strText;

                xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
"", "", xmleLastElement, strText);
            }
        }
    }
}

```

```

        }
    } else {
        xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element(strType, strTag, strAttributes, xmleLastElement, strText);
        if (strText != "")
xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
"", "", xmleLastElement, strText);
    }
} else {
    xmleLastElement = xmleLastElement.parentElement;
    iElements--;
    if (xmleLastElement && strText != "") {
        xmleLastElement.text += strText;
        xmleLastElement.childElements[xmleLastElement.childElements.length] = new
REXML_XML_Element("text", "", "", xmleLastElement, strText);
    }
}
}
}

function REXML_XML_Element(strType, strName, strAttributes, xmlParent, strText) {
    this.type = strType;
    this.name = strName;
    this.attributeString = strAttributes;
    this.attributes = null;
    this.childElements = new Array();
    this.parentElement = xmlParent;
    this.text = strText; // text of element
    this.getText = REXML_XML_Element_getText; // text of element and child elements
    this.childElement = REXML_XML_Element_childElement;
    this.attribute = REXML_XML_Element_attribute;
}

function REXML_XML_Element_getText() {
    if (this.type == "text" || this.type == "cdata") {
        return this.text;
    } else if (this.childElements.length) {
        var L = "";
        for (var i=0; i<this.childElements.length; i++) {
            L += this.childElements[i].getText();
        }
        return L;
    } else return "";
}

function REXML_XML_Element_childElement(strElementName) {
    for (var i=0; i<this.childElements.length; i++) if (this.childElements[i].name == strElementName) return
this.childElements[i];
    return null;
}

function REXML_XML_Element_attribute(strAttributeName) {

```

```

        if (!this.attributes) {
            var reAttributes = new RegExp(" ([^= ]*)=", "g"); // matches attributes
            if (this.attributeString.match(reAttributes) && this.attributeString.match(reAttributes).length) {
                var arrAttributes = this.attributeString.match(reAttributes);
                if (!arrAttributes.length) arrAttributes = null;
                else for (var j=0; j<arrAttributes.length; j++) {
                    arrAttributes[j] = new Array(
                        (arrAttributes[j]+"").replace(/([= ]/g, "")),
                        ParseAttribute(this.attributeString,
                            (arrAttributes[j]+"").replace(/([= ]/g, ""))
                        );
                }
                this.attributes = arrAttributes;
            }
        }
        if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == strAttributeName) return
        this.attributes[i][1];
        return "";
    }
}

function JSXMLElementBuilder() {
    this.XML = "";
    this.elements = new Array();
    Array.prototype.remove = Array_Remove;
    Array.prototype.add = Array_Add;
    this.load = JSXMLElementBuilder_load;
    this.element = JSXMLElementBuilder_element;
    this.addElementAt = JSXMLElementBuilder_addElementAt;
    this.insertElementAt = JSXMLElementBuilder_insertElementAt;
    this.removeElement = JSXMLElementBuilder_removeElement;
    this.generateXML = JSXMLElementBuilder_generateXML;
    this.moveElement = JSXMLElementBuilder_moveElement;
}

function JSXMLElementBuilder_load(strXML, xmleElem) {
    this.XML = strXML;
    if (!xmleElem) {
        if (strXML.length) xmleElem = (new REXML(strXML)).rootElement;
        else return false;
    }
    var xmlBuilder = new JSXMLElementIterator(xmleElem);
    while (true) {
        if (xmlBuilder.xmleElem.type == "element") {
            if (xmlBuilder.xmleElem.attributes) {
                this.addElementAt(xmlBuilder.xmleElem.name, xmlBuilder.xmleElem.attributes,
                    xmlBuilder.xmleElem.text, this.elements.length, xmlBuilder.iElemLevel);
            } else {
                this.addElementAt(xmlBuilder.xmleElem.name, xmlBuilder.xmleElem.attributeString,
                    xmlBuilder.xmleElem.text, this.elements.length, xmlBuilder.iElemLevel);
            }
        }
    }
}

```

```

        if (!xmlBuilder.getNextNode(false)) break;
    }
    for (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
}
function JSXMLElement_element(iIndex) {
    return this.elements[iIndex];
}
function JSXMLElement_addElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {
    iElemIndex = parseInt(iElemIndex);
    iElemLevel = parseInt(iElemLevel);
    if (iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex = (this.elements.length>0) ?
this.elements.length-1 : 0;
    if (iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel = this.elements[iElemIndex-1].level;
    if (!Attributes) Attributes = "";
    var Elem = new Array();
    var iAddIndex = iElemIndex;
    if (iElemIndex > 0) {
        for (var i=iElemIndex; i<this.elements.length; i++) if (this.elements[i].level > iElemLevel) iAddIndex++;
        else if (this.elements[i].level <= this.elements[iElemIndex].level) break;
        Elem = new JSXMLElement_XML_Element(strElement,Attributes,strText,iElemLevel+1,this);
    } else {
        Elem = new JSXMLElement_XML_Element(strElement,Attributes,strText,1,this);
    }
    this.elements = this.elements.add(iAddIndex,Elem);
    for (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
}
function JSXMLElement_insertElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {
    iElemIndex = parseInt(iElemIndex);
    iElemLevel = parseInt(iElemLevel);
    if (iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex = (this.elements.length>0) ?
this.elements.length-1 : 0;
    if (iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel = this.elements[iElemIndex-1].level;
    if (!Attributes) Attributes = "";
    var Elem = null;
    var iAddIndex = iElemIndex;
    if (iElemIndex > 0 && iElemLevel > 0) {
        Elem = new JSXMLElement_XML_Element(strElement,Attributes,strText,iElemLevel+1,this);
    } else {
        Elem = new JSXMLElement_XML_Element(strElement,Attributes,strText,1,this);
    }
    this.elements = this.elements.add(iAddIndex,Elem);
    for (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
}
function JSXMLElement_removeElement(iElemIndex) {
    iElemIndex = parseInt(iElemIndex);
    for (var iAfterElem=iElemIndex+1; iAfterElem<this.elements.length; iAfterElem++) if (this.elements[iAfterElem].level <
this.elements[iElemIndex].level+1) break;
    this.elements = this.elements.slice(0,iElemIndex).concat(this.elements.slice(iAfterElem,this.elements.length));
    for (var i=iElemIndex; i<this.elements.length; i++) this.elements[i].index = i;
}

```

```

}
function JSXMLElement_moveElement(iElem1Index,iElem2Index) {
    var arrElem1Elements = new Array(this.elements[iElem1Index]);
    var arrElem2Elements = new Array(this.elements[iElem2Index]);
    for (var i=iElem1Index; i<this.elements.length; i++) if (this.elements[i].level > this.elements[iElem1Index].level)
arrElem1Elements[arrElem1Elements.length] = this.elements[i]; else if (i>iElem1Index) break;
    for (var i=iElem2Index; i<this.elements.length; i++) if (this.elements[i].level > this.elements[iElem2Index].level)
arrElem2Elements[arrElem2Elements.length] = this.elements[i]; else if (i>iElem2Index) break;
    var arrMovedElements = new Array();
    if (iElem1Index < iElem2Index) {
        for (i=0; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length] = this.elements[i]; // start to the 1st
element
        for (i=iElem1Index+arrElem1Elements.length; i<iElem2Index+arrElem2Elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 1st element to end of 2nd element
        for (i=0; i<arrElem1Elements.length; i++) arrMovedElements[arrMovedElements.length] =
arrElem1Elements[i]; // 1st element and all child elements
        for (i=iElem2Index+arrElem2Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 2nd element to end
        this.elements = arrMovedElements;
    } else {
        for (i=0; i<iElem2Index; i++) arrMovedElements[arrMovedElements.length] = this.elements[i]; // start to the 2nd
element
        for (i=0; i<arrElem1Elements.length; i++) arrMovedElements[arrMovedElements.length] =
arrElem1Elements[i]; // 1st element and all child elements
        for (i=iElem2Index; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length] = this.elements[i]; // 2nd
element to 1st element
        for (i=iElem1Index+arrElem1Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 1st element to end
        this.elements = arrMovedElements;
    }
    for (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
}
function JSXMLElement_generateXML(bXMLTag) {
    var strXML = "";
    var arrXML = new Array();
    if (bXMLTag) strXML += '<?xml version="1.0"?>\n\n';
    for (var i=0; i<this.elements.length; i++) {
        strXML += RepeatChar("\t",this.elements[i].level-1);
        strXML += "<" + this.element(i).name // open tag
        if (this.element(i).attributes) {
            for (var j=0; j<this.element(i).attributes.length; j++) { // set attributes
                if (this.element(i).attributes[j]) {
                    strXML += ' ' + this.element(i).attributes[j][0] + '=' +
this.element(i).attributes[j][1] + ' ';
                }
            }
        } else strXML += this.element(i).attributeString.replace(/[/>]$/gi, "");
        if (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next element is a lower or equal
to

```

```

        (!this.elements[i+1] && this.elements[i-1])) // no next element, previous element
        && this.element(i).text == "" ) {
            strXML += "/";
        }
        strXML += ">";
        if (this.element(i).text != "") strXML += this.element(i).text;
        else strXML += "\n";
        if (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next element is a lower or equal
to
            (!this.elements[i+1] && this.elements[i-1])) // no next element, previous element
            && this.element(i).text != "") strXML += "</" + this.element(i).name + ">\n";
        if (!this.elements[i+1]) {
            lastelem = i;
            for (var j=i; j>-1; j--) {
                if (this.elements[j].level >= this.elements[i].level) continue;
                else {
                    if (this.elements[j].level < this.elements[lastelem].level) {
                        strXML += RepeatChar("\t",this.elements[j].level-1) + "</"
+ this.element(j).name + ">\n";
                        lastelem = j;
                    }
                }
            }
        } else {
            if (this.elements[i+1].level < this.elements[i].level) {
                lastelem = i;
                for (var j=i; this.elements[j].level>=this.elements[i+1].level; j--) {
                    if (this.elements[i] && this.elements[j] && this.elements[j].level <
this.elements[i].level && this.elements[j].level < this.elements[lastelem].level) {
                        strXML += RepeatChar("\t",this.elements[j].level-1) + "</"
+ this.element(j).name + ">\n";
                        lastelem = j;
                    }
                }
            }
        }
        if (strXML.length > 1000) {
            arrXML[arrXML.length] = strXML;
            strXML = "";
        }
    }
    arrXML[arrXML.length] = strXML;
    return arrXML.join("");
}

function JSXMLElement(strName,Attributes,strText,iLevel,xmlBuilder) {
    this.type = "element";
    this.name = strName;
    this.attributes = (typeof(Attributes) != "string") ? Attributes : null;
    this.attributeString = (typeof(Attributes) == "string") ? Attributes : "";

```

```

    this.text = strText;
    this.level = iLevel;
    this.index = -1;
    this.xmlBuilder = xmlBuilder;
    this.parseAttributes = JSXMLElement_parseAttributes;
    this.attribute = JSXMLElement_attribute;
    this.setAttribute = JSXMLElement_setAttribute;
    this.removeAttribute = JSXMLElement_removeAttribute;
    this.parentElement = JSXMLElement_parentElement;
    this.childElement = JSXMLElement_childElement;
}

function JSXMLElement_parseAttributes() {
    if (!this.attributes) {
        var reAttributes = new RegExp(" ([^= ]*)=", "g"); // matches attributes
        if (this.attributeString.match(reAttributes) && this.attributeString.match(reAttributes).length) {
            var arrAttributes = this.attributeString.match(reAttributes);
            if (!arrAttributes.length) arrAttributes = null;
            else for (var j=0; j<arrAttributes.length; j++) {
                arrAttributes[j] = new Array(
                    (arrAttributes[j]+"").replace(/[= ]/g, ""),
                    ParseAttribute(this.attributeString,
(arrAttributes[j]+"").replace(/[= ]/g, ""))
                );
            }
            this.attributes = arrAttributes;
        }
    }
}

function JSXMLElement_attribute(AttributeName) {
    if (!this.attributes) this.parseAttributes();
    if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName) return
this.attributes[i][1];
    return "";
}

function JSXMLElement_setAttribute(AttributeName, Value) {
    if (!this.attributes) this.parseAttributes();
    if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName) {
        this.attributes[i][1] = Value;
        return;
    }
    this.attributes[this.attributes.length] = new Array(AttributeName, Value);
}

function JSXMLElement_removeAttribute(AttributeName, Value) {
    if (!this.attributes) this.parseAttributes();
    if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName) {
        this.attributes = this.attributes.remove(i);
        return;
    }
}

```



```

    }
    function JSXMLElement_parentElement() {
        for (var i=this.index; this.xmlBuilder.element(i) && this.xmlBuilder.element(i).level != this.level-1; i--);
        return this.xmlBuilder.element(i);
    }
    function JSXMLElement_childElement(Child) {
        var iFind = -1;
        for (var i=this.index+1; i<this.xmlBuilder.elements.length; i++) {
            if (this.xmlBuilder.elements[i].level == this.level+1) {
                iFind++;
                if (iFind == Child || this.xmlBuilder.elements[i].name == Child) return
this.xmlBuilder.elements[i];
            } else if (this.xmlBuilder.elements[i].level <= this.level) break;
        }
        return null;
    }
}
function JSXMLElementIterator(xmlElem) {
    this.xmlElem = xmlElem;

    this.iElemIndex = 0;
    this.arrElemIndex = new Array(0);
    this.iElemLevel = 0;
    this.iElem = 0;
    this.arrElemIndex[this.iElemLevel] = -1;
    this.getNextNode = JSXMLElementIterator_getNextNode;
}
function JSXMLElementIterator_getNextNode() {
    if (!this.xmlElem || this.iElemLevel<0) return false;
    if (this.xmlElem.childElements.length) { // move up
        this.arrElemIndex[this.iElemLevel]++;
        this.iElemIndex++;
        this.iElemLevel++;
        this.arrElemIndex[this.iElemLevel] = 0;
        this.xmlElem = this.xmlElem.childElements[0];
    } else { // move next
        this.iElemIndex++;
        this.arrElemIndex[this.iElemLevel]++;
        if (this.xmlElem.parentElement && this.xmlElem.parentElement.childElements.length &&
this.arrElemIndex[this.iElemLevel] < this.xmlElem.parentElement.childElements.length) this.xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
        else {
            if (this.iElemLevel>0) { // move down
                for (; this.iElemLevel > 0; this.iElemLevel--) {
                    if (this.xmlElem.parentElement &&
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]]) {
                        this.xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
                        this.iElemLevel++;
                    }
                }
            }
        }
    }
}

```

```

this.arrElemIndex.slice(0,this.iElemLevel+1);

this.arrElemIndex =

break;

} else {

this.xmlElem = this.xmlElem.parentElement;

}

}

this.iElemLevel--;

} else {

return false;

}

}

return (typeof(this.xmlElem) == "object" && this.iElemLevel > -1);

}

function ParseAttribute(str,Attribute) {

var str = str + ">";

if (str.indexOf(Attribute + "=">-1) var Attr = new RegExp("." + Attribute + "=[^']*.*>");

else if (str.indexOf(Attribute + "=">-1) var Attr = new RegExp("." + Attribute + "=[^']*.*>");

return str.replace(Attr, "$1");

}

function Array_Remove(c) {

var tmparr = new Array();

for (var i=0; i<this.length; i++) if (i!=c) tmparr[tmparr.length] = this[i];

return tmparr;

}

function Array_Add(c, cont) {

var tmparr = new Array();

for (var i=0; i<this.length; i++) {

if (i==c) tmparr[tmparr.length] = cont;

tmparr[tmparr.length] = this[i];

}

if (!tmparr[c]) tmparr[c] = cont;

return tmparr;

}

function RepeatChar(sChar,iNum) {

var L = "";

for (var i=0; i<iNum; i++) L += sChar;

return L;

}

]]>
</JS_Script>
<JS_Script name="packaging">
- <![CDATA[
function packageResource(resource, mimeType){
if((resource.right == play) &&
(mimeType.indexOf("text") > -1 || mimeType.indexOf("image") > -1)){
resource.right = "display";
}
}

```

```
// it must distinguish between play and display
var rights = "--" + resource.right + " ";

if(resource.count != null){
    rights += resource.count;
}
rights += " ";

if(resource.from != null){
    rights += resource.from;
}
rights += " ";

if(resource.to != null){
    rights += resource.to;
}
rights += " ";

var params = rights + " " + uriResources + resource.ID + mimeTypeetoExt(mimeType) + " " + uriContents + " " + uriRights;

execute(uriPackager + params);
}
]]>
</JS_Script>
</Rule_Body>
<Dependencies />
</AXCP_Rule>
</Definition>
</Rule>
```

### 6.3 AXMEDIS CP GRID Script: License\_parser.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="Rule_Axmedis.xsd">
<Header>
<Rule_Name>license_parser</Rule_Name>
<AXRID>axcprule:2fee4e75-7d59-4fa7-b13f-4191ad5db577</AXRID>
<Rule_Version />
<Rule_Type>AXCP</Rule_Type>
<Software_Name />
<Version_of_software />
<Date_of_production>2006-04-24</Date_of_production>
<Author />
<Affiliation />
<URL />
<Comment />
<Last_Modifications>2006-08-13</Last_Modifications>
<Terminal_ID />
<Cost />
<Work_Item_ID />
</Header>
<Schedule>
<Run>
<Date>2006-04-24</Date>
<Time>03:53:46</Time>
<Periodicity Unit="Day">0</Periodicity>
```

```

<Expiration_Date>2006-04-24</Expiration_Date>
<Expiration_Time>03:53:46</Expiration_Time>
</Run>
<Status>Inactive</Status>
</Schedule>
- <Definition>
- <AXCP_Rule>
- <Arguments>
- <Parameter Name="filename" Type="String">E:\Projects\JScript\AXMEDIS\license\axlicense.xml</Parameter>
</Arguments>
- <Rule_Body>
- <JS_Script name="main">
- <![CDATA[
viewer();
resolver();
]]>
</JS_Script>
- <JS_Script name="xml">
- <![CDATA[
////////////////////////////////
//////// JSXML XML Tools          //////////
//////// Ver 1.2 Jun 18 2001       //////////
//////// Copyright 2000 Peter Tracey //////////
//////// http://jsxml.homestead.com/ //////////
////
////      Objects:
////
////      REXML  ////   Regular Expression-based XML parser
////
////      JSXMLIterator  ////   Iterates through the tree structure without recursion
////
////      JSXMLBuilder  ////   Loads xml into a linear structure and provides
////      interface for adding and removing elements  ////   and setting attributes, generates XML
////
////      Utility functions:////
////      ParseAttribute
////      Takes string of attributes and attribute name
////      Returns attribute value
////
////      Array_Remove
////      Removes element in array
////
////      Array_Add
////      Adds element to array
////
////      RepeatChar
////      Repeats string specified number of times
////
////////////////////////////////
function REXML(XML) {
    this.XML = XML;
    this.rootElement = null;
    this.parse = REXML_parse;
}

```

```

    if (this.XML && this.XML != "") this.parse();
}

function REXML_parse() {
    var reTag = new RegExp("<([> / ]*)([>]*)>", "g"); // matches that tag name $1 and attribute string $2
    var reTagText = new RegExp("<([> / ]*)([>]*)>([<]*)", "g"); // matches tag name $1, attribute string $2, and
    text $3

    var strType = "";
    var strTag = "";
    var strText = "";
    var strAttributes = "";
    var strOpen = "";
    var strClose = "";
    var iElements = 0;
    var xmleLastElement = null;
    if (this.XML.length == 0) return;
    var arrElementsUnparsed = this.XML.match(reTag);
    var arrElementsUnparsedText = this.XML.match(reTagText);
    var i=0;
    if (arrElementsUnparsed[0].replace(reTag, "$1") == "?xml") i++;
    for (; i<arrElementsUnparsed.length; i++) {
        strTag = arrElementsUnparsed[i].replace(reTag, "$1");
        strAttributes = arrElementsUnparsed[i].replace(reTag, "$2");
        strText = arrElementsUnparsedText[i].replace(reTagText, "$3").replace(/[\r\n\t ]+/g, " "); // remove
        white space

        strClose = "";
        if (strTag.indexOf("[CDATA[") == 0) {
            strOpen = "<![CDATA[";
            strClose = "";
            strType = "cdata";
        } else if (strTag.indexOf("!--") == 0) {
            strOpen = "<!--";
            strClose = "-->";
            strType = "comment";
        } else if (strTag.indexOf("??") == 0) {
            strOpen = "<?";
            strClose = "?>";
            strType = "pi";
        } else strType = "element";
        if (strClose != "") {
            strText = "";
            if (arrElementsUnparsedText[i].indexOf(strClose) > -1) strText =
            arrElementsUnparsedText[i];

            else {
                for (; i<arrElementsUnparsed.length &&
                arrElementsUnparsedText[i].indexOf(strClose) == -1; i++) {
                    strText += arrElementsUnparsedText[i];
                }
                strText += arrElementsUnparsedText[i];
            }
        }
    }
}

```

```

        if (strText.substring(strOpen.length, strText.indexOf(strClose)) != "")
        {

            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element(strType,
            "", "", xmleLastElement, strText.substring(strOpen.length, strText.indexOf(strClose)));

            if (strType == "cdata") xmleLastElement.text +=
            strText.substring(strOpen.length, strText.indexOf(strClose));
        }
        if (strText.indexOf(strClose)+ strClose.length < strText.length) {

            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
            "", "", xmleLastElement, strText.substring(strText.indexOf(strClose)+ strClose.length, strText.length));

            if (strType == "cdata") xmleLastElement.text +=
            strText.substring(strText.indexOf(strClose)+ strClose.length, strText.length);
        }
        continue;
    }
    if (strText.replace(/ */g, "") == "") strText = "";
    if (arrElementsUnparsed[i].substring(1,2) != "/") {
        if (iElements == 0) {
            xmleLastElement = this.rootElement = new
            REXML_XML_Element(strType, strTag, strAttributes, null, strText);

            iElements++;
            if (strText != "")

            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
            "", "", xmleLastElement, strText);

        } else if (arrElementsUnparsed[i].substring(arrElementsUnparsed[i].length-
        2, arrElementsUnparsed[i].length-1) != "/") {

            xmleLastElement =
            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element(strType,
            strTag, strAttributes, xmleLastElement, "");

            iElements++;
            if (strText != "") {
                xmleLastElement.text += strText;

                xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
                "", "", xmleLastElement, strText);

            }
        } else {

            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element(strType,
            strTag, strAttributes, xmleLastElement, strText);

            if (strText != "")

            xmleLastElement.childElements[xmleLastElement.childElements.length] = new REXML_XML_Element("text",
            "", "", xmleLastElement, strText);

        }
    } else {

        xmleLastElement = xmleLastElement.parentElement;
        iElements--;
        if (xmleLastElement && strText != "") {

```

```

        xmlLastElement.text += strText;

        xmlLastElement.childElements[xmlLastElement.childElements.length] = new REXML_XML_Element("text",
        "", "", xmlLastElement, strText);

    }

}

}

function REXML_XML_Element(strType, strName, strAttributes, xmlParent, strText) {
    this.type = strType;
    this.name = strName;
    this.attributeString = strAttributes;
    this.attributes = null;
    this.childElements = new Array();
    this.parentElement = xmlParent;
    this.text = strText; // text of element
    this.getText = REXML_XML_Element_getText; // text of element and child elements
    this.childElement = REXML_XML_Element_childElement;
    this.attribute = REXML_XML_Element_attribute;
}

function REXML_XML_Element_getText() {
    if (this.type == "text" || this.type == "cdata") {
        return this.text;
    } else if (this.childElements.length) {
        var L = "";
        for (var i=0; i<this.childElements.length; i++) {
            L += this.childElements[i].getText();
        }
        return L;
    } else return "";
}

function REXML_XML_Element_childElement(strElementName) {
    for (var i=0; i<this.childElements.length; i++) if (this.childElements[i].name == strElementName)
return this.childElements[i];

    return null;
}

function REXML_XML_Element_attribute(strAttributeName) {
    if (!this.attributes) {
        var reAttributes = new RegExp(" ([^= ]*)=", "g"); // matches attributes
        if (this.attributeString.match(reAttributes) &&
this.attributeString.match(reAttributes).length) {

            var arrAttributes = this.attributeString.match(reAttributes);
            if (!arrAttributes.length) arrAttributes = null;
            else for (var j=0; j<arrAttributes.length; j++) {
                arrAttributes[j] = new Array(
                    (arrAttributes[j]+"").replace(/[/= ]/g, ""),
                    ParseAttribute(this.attributeString,
(arrAttributes[j]+"").replace(/[/= ]/g, ""))

```

```

    }
    this.attributes = arrAttributes;
  }
}
if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] ==
strAttributeName) return this.attributes[i][1];
return "";
}
function JSXMLElementBuilder() {
  this.XML = "";
  this.elements = new Array();
  Array.prototype.remove = Array_Remove;
  Array.prototype.add = Array_Add;
  this.load = JSXMLElementBuilder_load;
  this.element = JSXMLElementBuilder_element;
  this.addElementAt = JSXMLElementBuilder_addElementAt;
  this.insertElementAt = JSXMLElementBuilder_insertElementAt;
  this.removeElement = JSXMLElementBuilder_removeElement;
  this.generateXML = JSXMLElementBuilder_generateXML;
  this.moveElement = JSXMLElementBuilder_moveElement;
}

function JSXMLElementBuilder_load(strXML, xmleElem) {
  this.XML = strXML;
  if (!xmleElem) {
    if (strXML.length) xmleElem = (new REXML(strXML)).rootElement;
    else return false;
  }
  var xmlBuilder = new JSXMLElementIterator(xmleElem);
  while (true) {
    if (xmlBuilder.xmlElem.type == "element") {
      if (xmlBuilder.xmlElem.attributes) {
        this.addElementAt(xmlBuilder.xmlElem.name,xmlBuilder.xmlElem.attributes, xmlBuilder.xmlElem.text,
this.elements.length, xmlBuilder.iElemLevel);
      } else {
        this.addElementAt(xmlBuilder.xmlElem.name,xmlBuilder.xmlElem.attributeString, xmlBuilder.xmlElem.text,
this.elements.length, xmlBuilder.iElemLevel);
      }
    }
    if (!xmlBuilder.getNextNode(false)) break;
  }
  for (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
}

function JSXMLElementBuilder_element(iIndex) {
  return this.elements[iIndex];
}

function JSXMLElementBuilder_addElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {

```



```

        iElemIndex = parseInt(iElemIndex);
        iElemLevel = parseInt(iElemLevel);
        if ((iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex =
(this.elements.length>0) ? this.elements.length-1 : 0;
        if ((iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel =
this.elements[iElemIndex-1].level;
        if (!Attributes) Attributes = "";
        var Elem = new Array();
        var iAddIndex = iElemIndex;
        if (iElemIndex > 0) {
            for (var i=iElemIndex; i<this.elements.length; i++) if (this.elements[i].level > iElemLevel)
iAddIndex++;

            else if (this.elements[i].level <= this.elements[iElemIndex].level) break;
            Elem = new JSXMLElement(strElement,Attributes,strText,iElemLevel+1,this);
        } else {
            Elem = new JSXMLElement(strElement,Attributes,strText,1,this);
        }
        this.elements = this.elements.add(iAddIndex,Elem);
        for (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
    }

    function JSXMLElement_insertElementAt(strElement,Attributes,strText,iElemIndex,iElemLevel) {
        iElemIndex = parseInt(iElemIndex);
        iElemLevel = parseInt(iElemLevel);
        if ((iElemIndex < 0 || typeof(iElemIndex) != "number" || isNaN(iElemIndex)) iElemIndex =
(this.elements.length>0) ? this.elements.length-1 : 0;
        if ((iElemLevel < 0 || typeof(iElemLevel) != "number" || isNaN(iElemLevel)) iElemLevel =
this.elements[iElemIndex-1].level;
        if (!Attributes) Attributes = "";
        var Elem = null;
        var iAddIndex = iElemIndex;
        if (iElemIndex > 0 && iElemLevel > 0) {
            Elem = new JSXMLElement(strElement,Attributes,strText,iElemLevel+1,this);
        } else {
            Elem = new JSXMLElement(strElement,Attributes,strText,1,this);
        }
        this.elements = this.elements.add(iAddIndex,Elem);
        for (var i=iAddIndex; i<this.elements.length; i++) this.elements[i].index = i;
    }

    function JSXMLElement_removeElement(iElemIndex) {
        iElemIndex = parseInt(iElemIndex);
        for (var iAfterElem=iElemIndex+1; iAfterElem<this.elements.length; iAfterElem++) if
(this.elements[iAfterElem].level < this.elements[iElemIndex].level+1) break;
        this.elements = this.elements.slice(0,iElemIndex).concat(this.elements.slice(iAfterElem,this.elements.length));
        for (var i=iElemIndex; i<this.elements.length; i++) this.elements[i].index = i;
    }

    function JSXMLElement_moveElement(iElem1Index,iElem2Index) {
        var arrElem1Elements = new Array(this.elements[iElem1Index]);
        var arrElem2Elements = new Array(this.elements[iElem2Index]);

```

```

        for (var i=iElem1Index; i<this.elements.length; i++) if (this.elements[i].level > this.elements[iElem1Index].level)
arrElem1Elements[arrElem1Elements.length] = this.elements[i]; else if (i>iElem1Index) break;
        for (var i=iElem2Index; i<this.elements.length; i++) if (this.elements[i].level > this.elements[iElem2Index].level)
arrElem2Elements[arrElem2Elements.length] = this.elements[i]; else if (i>iElem2Index) break;
        var arrMovedElements = new Array();
        if (iElem1Index < iElem2Index) {
            for (i=0; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length] = this.elements[i]; //
start to the 1st element
            for (i=iElem1Index+arrElem1Elements.length; i<iElem2Index+arrElem2Elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 1st element to end of 2nd element
            for (i=0; i<arrElem1Elements.length; i++) arrMovedElements[arrMovedElements.length] =
arrElem1Elements[i]; // 1st element and all child elements
            for (i=iElem2Index+arrElem2Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 2nd element to end
            this.elements = arrMovedElements;
        } else {
            for (i=0; i<iElem2Index; i++) arrMovedElements[arrMovedElements.length] = this.elements[i]; //
start to the 2nd element
            for (i=0; i<arrElem1Elements.length; i++) arrMovedElements[arrMovedElements.length] =
arrElem1Elements[i]; // 1st element and all child elements
            for (i=iElem2Index; i<iElem1Index; i++) arrMovedElements[arrMovedElements.length] =
this.elements[i]; // 2nd element to 1st element
            for (i=iElem1Index+arrElem1Elements.length; i<this.elements.length; i++)
arrMovedElements[arrMovedElements.length] = this.elements[i]; // end of 1st element to end
            this.elements = arrMovedElements;
        }
        for (var i=0; i<this.elements.length; i++) this.elements[i].index = i;
    }
    function JSXMLElement_generateXML(bXMLTag) {
        var strXML = "";
        var arrXML = new Array();
        if (bXMLTag) strXML += '<?xml version="1.0"?>\n\n'
        for (var i=0; i<this.elements.length; i++) {
            strXML += RepeatChar("\t",this.elements[i].level-1);
            strXML += "<" + this.element(i).name // open tag
            if (this.element(i).attributes) {
                for (var j=0; j<this.element(i).attributes.length; j++) { // set attributes
                    if (this.element(i).attributes[j]) {
                        strXML += ' ' + this.element(i).attributes[j][0] + '=' +
this.element(i).attributes[j][1] + ' ';
                    }
                }
            } else strXML += this.element(i).attributeString.replace(/[\>]$/gi, "");
            if (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next element is a
lower or equal to
                (!this.elements[i+1] && this.elements[i-1])) // no next element, previous element
                && this.element(i).text == "") {
                strXML += "/";
            }
        }
    }

```

```

        strXML += ">";
        if (this.element(i).text != "") strXML += this.element(i).text;
        else strXML += "\n";
        if (((this.elements[i+1] && this.elements[i+1].level <= this.elements[i].level) || // next element is a
lower or equal to
                (!this.elements[i+1] && this.elements[i-1])) // no next element, previous element
                && this.element(i).text != "") strXML += "</" + this.element(i).name + ">\n";
        if (!this.elements[i+1]) {
            lastelem = i;
            for (var j=i; j>-1; j--) {
                if (this.elements[j].level >= this.elements[i].level) continue;
                else {
                    if (this.elements[j].level < this.elements[lastelem].level) {
                        strXML +=
RepeatChar("\t",this.elements[j].level-1) + "</" + this.element(j).name + ">\n";
                        lastelem = j;
                    }
                }
            }
        } else {
            if (this.elements[i+1].level < this.elements[i].level) {
                lastelem = i;
                for (var j=i; this.elements[j].level>=this.elements[i+1].level; j--) {
                    if (this.elements[i] && this.elements[j] &&
this.elements[j].level < this.elements[i].level && this.elements[j].level < this.elements[lastelem].level) {
                        strXML +=
RepeatChar("\t",this.elements[j].level-1) + "</" + this.element(j).name + ">\n";
                        lastelem = j;
                    }
                }
            }
        }
        if (strXML.length > 1000) {
            arrXML[arrXML.length] = strXML;
            strXML = "";
        }
    }
    arrXML[arrXML.length] = strXML;
    return arrXML.join("");
}

function JSXMLBuilder_XMLElement(strName,Attributes,strText,iLevel,xmlBuilder) {
    this.type = "element";
    this.name = strName;
    this.attributes = (typeof(Attributes) != "string") ? Attributes : null;
    this.attributeString = (typeof(Attributes) == "string") ? Attributes : "";
    this.text = strText;
    this.level = iLevel;
    this.index = -1;
    this.xmlBuilder = xmlBuilder;

```

```

        this.parseAttributes = JSXMLElement_parseAttributes;
        this.attribute = JSXMLElement_attribute;
        this.setAttribute = JSXMLElement_setAttribute;
        this.removeAttribute = JSXMLElement_removeAttribute;
        this.parentElement = JSXMLElement_parentElement;
        this.childElement = JSXMLElement_childElement;
    }

    function JSXMLElement_parseAttributes() {
        if (!this.attributes) {
            var reAttributes = new RegExp("([^\s]*)=\"", "g"); // matches attributes
            if (this.attributeString.match(reAttributes) &&
this.attributeString.match(reAttributes).length) {

                var arrAttributes = this.attributeString.match(reAttributes);
                if (!arrAttributes.length) arrAttributes = null;
                else for (var j=0; j<arrAttributes.length; j++) {
                    arrAttributes[j] = new Array(
                        (arrAttributes[j]+"").replace(/([^\s]*)=\",
                        ParseAttribute(this.attributeString,
(arrAttributes[j]+"").replace(/([^\s]*)=\",

                );
            }
            this.attributes = arrAttributes;
        }
    }

    function JSXMLElement_attribute(AttributeName) {
        if (!this.attributes) this.parseAttributes();
        if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName)
return this.attributes[i][1];

        return "";
    }

    function JSXMLElement_setAttribute(AttributeName, Value) {
        if (!this.attributes) this.parseAttributes();
        if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName)
{
            this.attributes[i][1] = Value;
            return;
        }
        this.attributes[this.attributes.length] = new Array(AttributeName, Value);
    }

    function JSXMLElement_removeAttribute(AttributeName, Value) {
        if (!this.attributes) this.parseAttributes();
        if (this.attributes) for (var i=0; i<this.attributes.length; i++) if (this.attributes[i][0] == AttributeName)
{
            this.attributes = this.attributes.remove(i);
            return;
        }
    }
}

```

```

function JSXMLElement_parentElement() {
    for (var i=this.index; this.xmlBuilder.element(i) && this.xmlBuilder.element(i).level != this.level-1; i-
-);

    return this.xmlBuilder.element(i);
}
function JSXMLElement_childElement(Child) {
    var iFind = -1;
    for (var i=this.index+1; i<this.xmlBuilder.elements.length; i++) {
        if (this.xmlBuilder.elements[i].level == this.level+1) {
            iFind++;
            if (iFind == Child || this.xmlBuilder.elements[i].name == Child) return
this.xmlBuilder.elements[i];
        } else if (this.xmlBuilder.elements[i].level <= this.level) break;
    }
    return null;
}
function JSXMLElementIterator(xmlElem) {
    this.xmlElem = xmlElem;

    this.iElemIndex = 0;
    this.arrElemIndex = new Array(0);
    this.iElemLevel = 0;
    this.iElem = 0;
    this.arrElemIndex[this.iElemLevel] = -1;
    this.getNextNode = JSXMLElementIterator_getNextNode;
}
function JSXMLElementIterator_getNextNode() {
    if (!this.xmlElem || this.iElemLevel<0) return false;
    if (this.xmlElem.childElements.length) { // move up
        this.arrElemIndex[this.iElemLevel]++;
        this.iElemIndex++;
        this.iElemLevel++;
        this.arrElemIndex[this.iElemLevel] = 0;
        this.xmlElem = this.xmlElem.childElements[0];
    } else { // move next
        this.iElemIndex++;
        this.arrElemIndex[this.iElemLevel]++;
        if (this.xmlElem.parentElement && this.xmlElem.parentElement.childElements.length &&
this.arrElemIndex[this.iElemLevel] < this.xmlElem.parentElement.childElements.length) this.xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
        else {
            if (this.iElemLevel>0) { // move down
                for (; this.iElemLevel > 0; this.iElemLevel--) {
                    if (this.xmlElem.parentElement &&
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]]) {
                        this.xmlElem =
this.xmlElem.parentElement.childElements[this.arrElemIndex[this.iElemLevel]];
                        this.iElemLevel++;
                    }
                }
            }
        }
    }
}

```

```

this.arrElemIndex.slice(0,this.iElemLevel+1);

this.xmlElem.parentElement;

        this.arrElemIndex =
        break;
    } else {
        this.xmlElem =
    }
    }
    this.iElemLevel--;
} else {
    return false;
}
}
return (typeof(this.xmlElem) == "object" && this.iElemLevel > -1);
}
function ParseAttribute(str,Attribute) {
    var str = str + ">";
    if (str.indexOf(Attribute + "=">-1) var Attr = new RegExp("." + Attribute + "='([^\']*).*>");
    else if (str.indexOf(Attribute + "'>-1) var Attr = new RegExp("." + Attribute + "'='([^\']*).*>");
    return str.replace(Attr, "$1");
}
function Array_Remove(c) {
    var tmparr = new Array();
    for (var i=0; i<this.length; i++) if (i!=c) tmparr[tmparr.length] = this[i];
    return tmparr;
}
function Array_Add(c, cont) {
    var tmparr = new Array();
    for (var i=0; i<this.length; i++) {
        if (i==c) tmparr[tmparr.length] = cont;
        tmparr[tmparr.length] = this[i];
    }
    if (!tmparr[c]) tmparr[c] = cont;
    return tmparr;
}
function RepeatChar(sChar,iNum) {
    var L = "";
    for (var i=0; i<iNum; i++) L += sChar;
    return L;
}
]]>
</JS_Script>
= <JS_Script name="oma">
    = <![CDATA[
    function oma(){
        this.issuer = null;
        this.resources = new Array();
        this.print = omaprint;
    }

```

```

function resource(){
    this.ID = null;
    this.right = null;
    this.count = null;
    this.from = null;
    this.to = null;
    this.principal = null;//redundant
    this.print = resourceprint;
}
function omaprint(){
    print("issuer: " + this.issuer);

    var i = 0;
    for(i in this.resources){
        this.resources[i].print();
    }
}
function resourceprint(){
    print("ID: " + this.ID);
    print("  right: " + this.right);
    print("  count: " + this.count);
    print("  from: " + this.from);
    print("  to: " + this.to);
    print("  principal: " + this.principal);
}
]]>
</JS_Script>
= <JS_Script name="viewer">
  = <![CDATA[
    var level;
    var tab;
    function viewer(){
        var xml = readFromFile(filename);
        var xmldoc = new REXML(xml);

        level = 0;
        tab = " ";
        print(xmldoc.rootElement.name)
        show(xmldoc.rootElement);
    }
    function show(element){
        var i = 0;
        for(i in element.childElements){
            var current = element.childElements[i];
            switch(current.type){
                case "element":
                    print(RepeatChar(tab, level+1) + current.name);
                    level++;
                    show(current);
                    level--;

```

```

        break;
    case "text":
        print(RepeatChar(tab, level+1) + current.text);
    case "comment":
    case "pi":
    case "cdata":
        break;
    }
}
}
]]>
</JS_Script>
=<JS_Script name="resolver">
=<![CDATA[
var omaobj;
function resolver(){
    var xml = readFromFile(filename);
    var xmldoc = new REXML(xml);

    omaobj = new oma();
    visit(xmldoc.rootElement);

    omaobj.print();
}
function visit(element){
    switch(element.name){
        case "r:issuer":
            omaobj.issuer = resolveIssuer(element);
            break;
        case "mx:diReference":
            omaobj.resources[omaobj.resources.length] = resolveResource(element);
            break;
    }

    var i = 0;
    for(i in element.childElements){
        var current = element.childElements[i];
        if(current.type == "element")
            visit(current);
    }
}
function resolveResource(element){
    var res = new resource();

    // ID
    res.ID = resolveID(element);

    // properties
    i = 0;
    var parent = element.parentElement;

```



```

for(i in parent.childElements){
  current = parent.childElements[i];
  switch(current.name){
    case "r:keyHolder":
      res.principal = resolvePrincipal(current);
      break;
    case "r:allConditions":
      var conditions = resolveConditions(current);
      res.count = conditions.count;
      res.from = conditions.from;
      res.to = conditions.to;
      break;
    case "mx:play":
    case "mx:print":
    case "mx:execute":
      res.right = current.name;
      break;
  }
}

return res;
}

function resolveIssuer(element){
  var keyholder = element.childElement("r:keyHolder");
  var info = keyholder.childElement("r:info");
  var keyname = info.childElement("dsig:KeyName");
  return keyname.text;
}

function resolveID(element){
  var identifier = element.childElement("mx:identifier");
  return identifier.text;
}

function resolvePrincipal(element){
  var info = element.childElement("r:info");
  var keyname = info.childElement("dsig:KeyName");
  return keyname.text;
}

function resolveConditions(element){
  var conditions = new Object();

  conditions.count = null;
  conditions.from = null;
  conditions.to = null;

  var i = 0;
  for(i in element.childElements){
    var current = element.childElements[i];
    switch(current.name){
      case "sx:exerciseLimit":

```

```

        var count = current.childElement("sx:count");
        conditions.count = count.text;
        break;
    case "r:validityInterval":
        var from = current.childElement("r:notBefore");
        var to = current.childElement("r:notAfter");
        conditions.from = from.text;
        conditions.to = to.text;
        break;
    }
}

return conditions;
}
]]>
</JS_Script>
</Rule_Body>
<Dependencies />
</AXCP_Rule>
</Definition>
</Rule>

```

#### 6.4 AXMEDIS CP GRID Script:resource\_extract\_o1.xml rule

```

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Rule xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="Rule_Axmedis.xsd">
  <Header>
    <Rule_Name>test01</Rule_Name>
    <AXRID>axcprule:23d701f8-480e-423c-9deb-ce465e59b491</AXRID>
    <Rule_Version />
    <Rule_Type>AXCP</Rule_Type>
    <Software_Name />
    <Version_of_software />
    <Date_of_production>2006-03-22</Date_of_production>
    <Author />
    <Affiliation />
    <URL />
    <Comment />
    <Last_Modifications>2006-08-17</Last_Modifications>
    <Terminal_ID />
    <Cost />
    <Work_Item_ID />
  </Header>
  <Schedule>
  <Run>
    <Date>2006-03-22</Date>
    <Time>21:47:13</Time>
    <Periodicity Unit="Day">0</Periodicity>
    <Expiration_Date>2006-03-22</Expiration_Date>
    <Expiration_Time>21:47:13</Expiration_Time>
  </Run>
  </Schedule>
</Rule>

```

```

    </Run>
    <Status>Inactive</Status>
    </Schedule>
- <Definition>
- <AXCP_Rule>
- <Arguments>
  <Parameter Name="output" Type="String">axobj01.xml</Parameter>
  <Parameter Name="input" Type="String">axobj01.xml</Parameter>
  <Parameter Name="bmp" Type="String">tile.bmp</Parameter>
  <Parameter Name="path"
    Type="String">E:\Projects\JScript\AXMEDIS\axobj\</Parameter>
  <Parameter Name="packager" Type="String">C:\Program Files\Sony Ericsson\DRM
    Packager\DRMPackager.exe</Parameter>
  </Arguments>
- <Rule_Body>
- <JS_Script name="main">
  - <![CDATA[
    var level;

    function load(){
      var axobj = new AxmedisObject(path + input);
      return axobj;
    }

    function extract(obj){
      var contents = obj.getContent();
      print(level + " = " + obj.AXOID);
      if(contents != null){
        var index;
        for(index in contents){
          var content = contents[index];
          if(content instanceof AxmedisObject){
            level++;
            extract(content);
            level--;
          }
          else{
            var filename = path + level + "_" + content.contentID;
            print(filename);
            content.save(filename);
          }
        }
      }
    }
  ]>

```

```
}

function make(){
    var axobj = new AxmedisObject();
    if(axobj != null){
        var bmpres = new AxResource();
        bmpres.load(path + bmp);
        axobj.addContent(bmpres);

        //var axres = load();
        //axobj.addContent(axres);

        axobj.save(path + output);
    }
}

function main(){
    //make();

    var axobj = load();
    //level = 0;
    //extract(axobj);

    //execute(packager);
    return 0;
}

main();
]]>
</JS_Script>
</Rule_Body>
<Dependencies />
</AXCP_Rule>
</Definition>
</Rule>
```

## 6.5 MyPackager.bat

```
@echo off
C:
cd "\\Program Files\\Sony Ericsson\\DRM Packager"
```

```
DRMPackager -p "Profile\main.dpr" -q -x --file "Profile\tmpTemplate.xml" --xml --uri "" --iconuri "" --name  
$fn --cid $id@dsi.unifi.it %1  
rem pause  
DRMPackager -f %2 -p "Profile\main.dpr" -q -rsep -g "Profile\tmpTemplate.xml" -d %3 -y %4
```

## References

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