

Multimedia Music Distribution and Sharing among Mediateques, Archives and their Attendees

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ABSTRACT

Archives of mediateques, theatres, music schools, conservatories, universities, etc., are the most important sources of cultural heritage. They are interested in digitizing content to (i) improve the service towards their attendees, increasing the number of collections provided, (ii) add new functionalities to the service provided, (iii) save the material which is going to deteriorate, such as tapes, disks, documents, etc. Publishers are interested in digitizing only content that guarantees a certain return of investment and at the same time they limit the distribution of their content which is located in the archives, so as to control its exploitation and to maintain the content ownership. WEDELMUSIC has been defined to allow content providers to share and distribute interactive music in the respect of the owner rights. This permits to create network of content sharing Mediateques in the respect of the owner rights. To this end, solutions, models and tools were defined and developed, including adequate protection and monitoring solutions.

Keywords: music distribution, music sharing, Digital Right Management, multimedia music Mediateques.

1 INTRODUCTION

Multimedia music publishers have in their archives audio files, music scores, documents, and images. Most of them are recently started campaigns to convert their music scores archives from paper to digital images. This is mainly performed for the pressure of the market. Information centers and historical publishers also have in their archives several other digital objects: posters, letters, pictures, lyric booklets, videos, etc. This material represents an important source for cultural heritage but it is typically not organized and quite rarely managed by an integrated Digital Asset Management database -- e.g., [10].

Also archives are very important sources of cultural heritage: independent mediateques or archives associated to theatres, orchestras, music schools, conservatories, museum, foundations, universities, etc. Most of them present non digital music objects such as audio (disks, cassettes, tapes, etc.), video tapes, documents and pictures. In most cases, the archives have accumulated their content (through donations, as years went by and the work of music lovers became more and more conspicuous), etc. Only

marginally, the content is acquired from publishers. Typically publishers send to the major archives free content. Most of the collected material in archives of music lovers comes from live performances and it is only partially covered by copyrights. Such content is for a large part non commercialized by publishers, for the lack of a real market. On the other hand, this material has a great cultural value for music lovers, students and experts whose are the typical the constant visitors of the archives. The mixture of protected and non-protected material in the archive and the difficulty of a clear distinction forced the archives to adopt restrictive policies for the use of the material. Usually, the archives can be freely consulted on-site, whereas the attendees are not enabled take excerpts, to make copies, to record, etc. This is a serious limit to the valorization and the visibility of very important archives and their content constraining the diffusion of non commercial content such as: music produced in regional folkloristic activities, original manuscripts, historical documentation, modern music of young composers, etc.

Publishers are not interested in digitizing all above mentioned contents, since they do not see the direct return of investment. The archives are the only content owners to be interested in digitizing that content to (i) improve the service for their clients, (ii) add new functionalities to the service provided, (iii) save the material that is subjected to deterioration such as tapes, disks, documents, etc. Their activity is very relevant to save the cultural heritage in this field.

This activity was positively understood and solicited in the past years through several national and international projects and International research programs: e-content of European Commission, e-culture, etc. In addition, several projects in the area of music archives have been launched such as: PARAGON (audio distribution and virtual catalog), CANTATE (sheet music distribution and virtual catalog), MUSIC Library online, Delos Network Libraries, HARMONICA forum, JUKEBOX, MUSICWEB, etc [8], [9]. Most of these projects and prototypes have been focussed on creating virtual archives by sharing cataloguing information.

The archives of the new age

The above mentioned context has placed the basis for a new generation of activities in the area of libraries and

archives: *the age of content sharing via Internet*.

The amount of multimedia content available in music archives has a strong potential if organized and distributed in multimedia products. The simple exploitation of that material to produce CDs and DVDs with authoring systems is only a small part of its potential because synchronization and music score integration with other elements, such as sliding shows, navigation in the content, animations, multimedia biographies, etc., are only few examples to mention. These integrated multimedia music objects can be used for different purposes: educational, entertainment, "edutainment", "infotainment", etc.

In most cases, the relationships among the single related elements of the archive are not explicitly established. For instance, the audio recording, the lyric, the historical details, and the music score of the same piece and version are not linked. Typically, it is only possible to regard those components as related each other by searching via cataloguing information for the same keyword, age, etc.

In several cases, the content owned by a single archive is not complete to produce integrated information. The real added value of virtual archives is to integrate their content to produce complete multimedia music objects.

An other important added value of virtual archives is the ability to propose new usages of the archives: automatic analysis tools, specialized devices such as devices for visually impaired people, specialized musical devices as MIDI keyboards, are only a few part of these possible new usages.

Copyright owners like publishers allow any content sharing, since archives can guarantee to keep under control the content by forbidding copies and uncontrolled duplications.

In this paper, the adoption of WEDELMUSIC to support the modeling and content sharing among archives is illustrated. In addition, an extension of WEDELMUSIC to allow the distribution of content from archives to final users is also presented. WEDELMUSIC has been defined to allow content providers to share and distribute interactive music according to a Business to Business Model, B2B, the extension also presented in paper introduce a Business to Client model, B2C. Music distribution and sharing is not achievable without adequate protection and monitoring solutions. WEDELMUSIC provides mechanisms for music protection, that include: protecting digital objects by using encryption techniques; allowing definition of Digital Rights Management policies; watermarking audio files, images of music score, and music sheets while they are printed [7]. Today, WEDELMUSIC solution has been adopted by Arcipelago Musica and Active Music Mediateques according to the sharing and distribution schema depicted in this paper. WEDELMUSIC is an IST project with partners: DSI, University of

Florence, Italy; ARTEC Group, Belgium; Casa Ricordi, Italy; FNB, The Netherlands; Scuola di Musica di Fiesole, Italy; IRCAM, France; FHG-IGD, Germany; ILSP, Greece; CESVIT, Italy; SUGARMUSIC Edizioni Suvini Zerboni, Italy.

The paper is organized as follow. In Section 2, a short overview of WEDELMUSIC format is reported. In Section 3, the model for distribution and sharing of WEDELMUSIC object among corporate institutions and distributors is presented. In Section 4, some aspects of registration, certification and a model that include a certification authority and collecting societies are discussed. Conclusions are drawn in Section 5.

2 WEDELMUSIC FORMAT

For music archives, it is very important to adopt music models presenting new functionalities with a particular attention to the aspects related to the interactivity, but always paying respect to the owner rights. WEDELMUSIC solution proposes techniques for storing, retrieving, distributing and sharing multimedia musical objects. WEDELMUSIC XML format [5] includes automatic formatting of symbolic music notation [1], [2], [6], images of music sheets, audio files, videos, documents, identification, classification, lyrics, images and audio etc., and a set of protection mechanisms and Digital Right Management aspects. In each WEDELMUSIC object, several relationships among its components can be established. These allow the definition and exploitation of new functionalities. For example, it is possible to: define hypermedia links to pass from a music notation symbol to a document, video, image, audio file; listen to real audio performance while visualizing the images of the music score or the symbolic music notation [4]; modify music notation symbols: formatting, arranging, fingering, adding/deleting notes, transposition, editing multilingual lyric, managing versioning, etc., in the respect of copyrights; print music score or other components; analyze music score, comparing and searching into the database, performing a piano reduction; extract excerpts of the music score, audio, and images of the music score; execute music notation, generating MIDI file or audio; edit music for visually impaired people, print music in Braille, get a verbal description of music score; acquire music from other

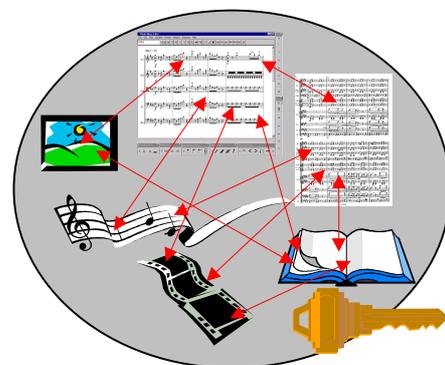


Fig. 1 -- WEDELMUSIC object schema

formats: FINALE, SCORE, SIBELIUS, MIDI; search music into the database on the basis of content (music melody, lyric, documents, etc.), searching music components and objects on the basis of classification and identification aspects. WEDELMUSIC format can be profitably used as a format for new emerging applications of music. Among these we can see: music distribution, Internet exploitation of music, cooperative editing of music, production and adoption of multimedia digital object based on music, distance learning/tuition of music, etc.

presents a piece of Uccellini. in which on the right the original music score sheet is visible, together with the original dedication to "Serenissimo Principe", the cover of the Basso Continuo, the page sheet ready to print already produced in WEDELMUSIC format with the music editor, and the audio player.

Most of above listed features are innovative and only possible through the WEDELMUSIC model. Classical features such as the MIDI/Audio Playing, visualization of music sheets or documents, etc., have to be considered innovative since in WEDELMUSIC they are allowed in the respect of the owner rights. To make possible the availability of such functionalities we designed a sophisticated set of tools to protect WEDELMUSIC objects and at the same time to permit and control the exploitation of such new functionalities.

3 DISTRIBUTION AND SHARING MUSIC

The WEDELMUSIC solution is based on several tools. They are referred to the general distribution architecture presented in Fig.3, among them:

- ◆ WEDELMUSIC editor and tool for producing music in WEDELMUSIC format, integrating the several multimedia aspects of music mentioned above with Digital Right Management rules. This tool is typically used by the Content Providers or by expert clients to build/produce WEDELMUSIC objects.
- ◆ WEDELMUSIC Server/Content-Distributor for the distribution of WEDELMUSIC objects on the Internet (in a protected or not-protected way). It integrates tools for watermarking audio files and music sheets, reading watermarks, encrypting, decrypting, managing the identification keys, managing the transaction, Digital Right Management, digital asset management, etc.
- ◆ WEDELMUSIC Local Distributor, LD, for interfacing the corporate music consumers (libraries, music schools, theatres, etc.) with the general servers and for providing music objects to the internal computers in the plant of the corporate consumer. An extended version of the Local Distributor is also capable of distributing WEDELMUSIC object to clients which are connected to it via Internet.
- ◆ Music Viewers and Listeners to visualize protected and non protected music in WEDELMUSIC format for clients (at home or in the Mediateque). On this tools are included: WEDELMUSIC music score editor, lyric editor, image sequence editor, video player, audio player, music notation format converts, fret board editor, etc.



Fig. 2 -- Examples of WEDELMUSIC objects

In the example of Fig.2, a WEDELMUSIC object representing the spring of Vivaldi is reported. It can be observed the symbolic representation of music scores, the audio player, a video player, an image viewer (the author's portrait) and the WEDELMUSIC editor presenting the Image Score of the original score sheet of Casa Ricordi, plus some symbol menus. Please remark on the left side of the figure, the WEDEL Editor shows the structure of the WEDELMUSIC object. The second example of Fig.2

Music distribution in digital (off-line or on-line via Internet) of music is acceptable for publishers and content owners only if supported by adequate protection mechanisms.

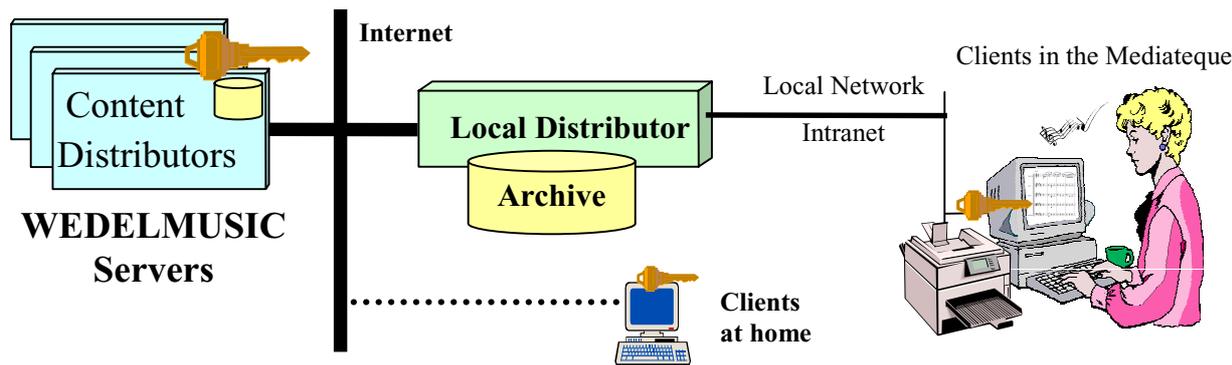


Fig. 3 -- Distribution architecture, B2B and B2C.

WEDELMUSIC enables publishers, distributors and content providers, to protect and keep under control their music/content when it is distributed and shared:

- On-line: music distribution via Internet (i) from content providers to corporate institutions (libraries, archives, etc.), (ii) from corporate institutions to final users, when they are at home or on their mobile equipment via Internet.
- Off-lines: music distribution via classical digital media such as DVD, CDs, etc., transferring the authorization and keeping under control the content usage via FAX, email, diskettes, or sporadic on-line connections.

At the same time, WEDELMUSIC solution allows the users to exploit above-mentioned functionalities for distributing/sharing content and its fruition.

Distribution Model

The LD manager may navigate on the WEB pages of the Publisher WEDELMUSIC Servers in order to select the WEDELMUSIC objects that he would like to have on the LD database. The Clients/Attendees of the LD are allowed to make queries to the LD database on the basis of cataloguing, identification and content aspects via a WEB interface shown in Fig.4. In the figure, it has been reported the classical interface that permit to produce the query on the Local Distributor archive.

Customization of the Local Distributor

Each registered user of the LD has also access to a private storage area, which permits to store personal data. For example, often-used queries can be stored in this area. For a musicologist using frequently the same objects, or requesting frequently the same objects in the database, this feature is very useful. For the same reason, a system of bookshelves can also be used. The end-user can store on bookshelves most frequently used objects, in order to retrieve easily on their next usage of the database.

In the WEDELMUSIC model, music analysis tools have been developed. These tools, which are able to extract from the score the most significant motives, the Figured Bass, or the cadences, are also able to store their results in the database, as excerpts of the score. The database can then be used to make queries on the basis of the content, by using the excerpts as a query criterion. These analysis tools can also be customized by end-users: end users can redefine the rules for cadences, or for harmony, the new rules being stored and shared in the database. Descriptions of analysis tools can be found in [11] and [12].

Open source development model

The needs of all LDs being very different, in terms of customization of the graphical interface or of the functionalities offered to the end-user, an open source development model is actually on study. Most of the source of the Local Distributor being written in PHP, and the architecture of the Local Distributor being very modular, separating as often as possible the data management from the HTML templates, this open source development model can be technically envisaged.

Enhancements to the client tools: the WEDELMUSIC Toolkit

Client tools, and especially WEDELMUSIC viewer, can be enhanced by development of plugins. A set of C++ APIs, available in the form of the WEDELMUSIC Toolkit, can be provided to developers. These APIs can be used, for example, as analysis tools does, to extract significant excerpts from the score, but also to develop specific functionalities, as Optical Music Recognition tools, MIDI tools, even specific end user devices - such as specific keyboards, or even to develop synchronization tools for the purpose of automatic synchronization between the score and a performance.

WEDELMUSIC client tools

The Clients uses the WEDELMUSIC viewers and listeners for visualizing and editing WEDELMUSIC objects. WEDELMUSIC objects may be built, encrypted on the content distributor site by using a specific key for each LD.

Protected files for each can be opened only by registered and certified WEDELMUSIC Clients of that LD. The certification of client pass through a specific process of the equipment identification and the exchange of registration keys with WEDELMUSIC organization as better described in the next Section.

The differences between protected and protected WEDELMUSIC objects are totally transparent for the Client-/User who receives the objects from the LD. The differences are obviously in the use of the object. Only non protected objects can be freely modified by the clients, while protected objects can be manipulated according to the digital right management rules enforced into the object itself.

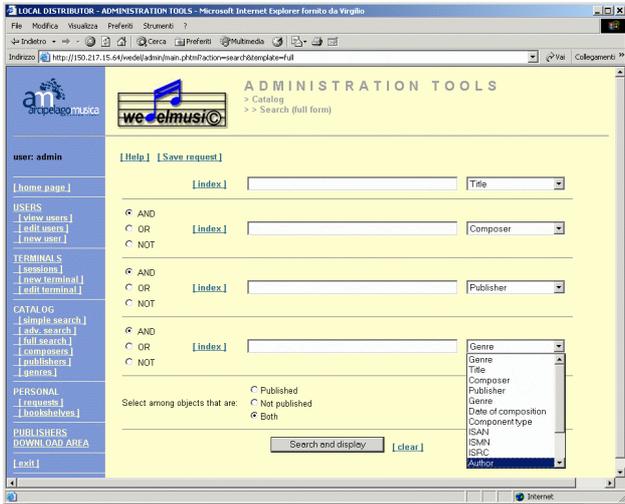


Fig. 4 -- Local Distributor WEB Interface

Sharing Music Content among Mediateques

The components of the above mentioned architecture can be used for building a large variety of solutions for multimedia and music content distribution. One of the most interesting solution allows the content sharing among corporate institutions. These can be archives, mediateques, second publishers, music shops, associations, etc. Content Distributors that are holding their WEDELMUSIC objects are capable to protect and distribute them to several LDs. In order to perform their job, they need to have the WEDELMUSIC Content Distributor/Server and Editor for building WEDELMUSIC objects.

In some cases, corporations hosting a LD are also interested in building their own WEDELMUSIC objects (e.g., music schools, theatres, etc.) and in distributing them to other LDs.

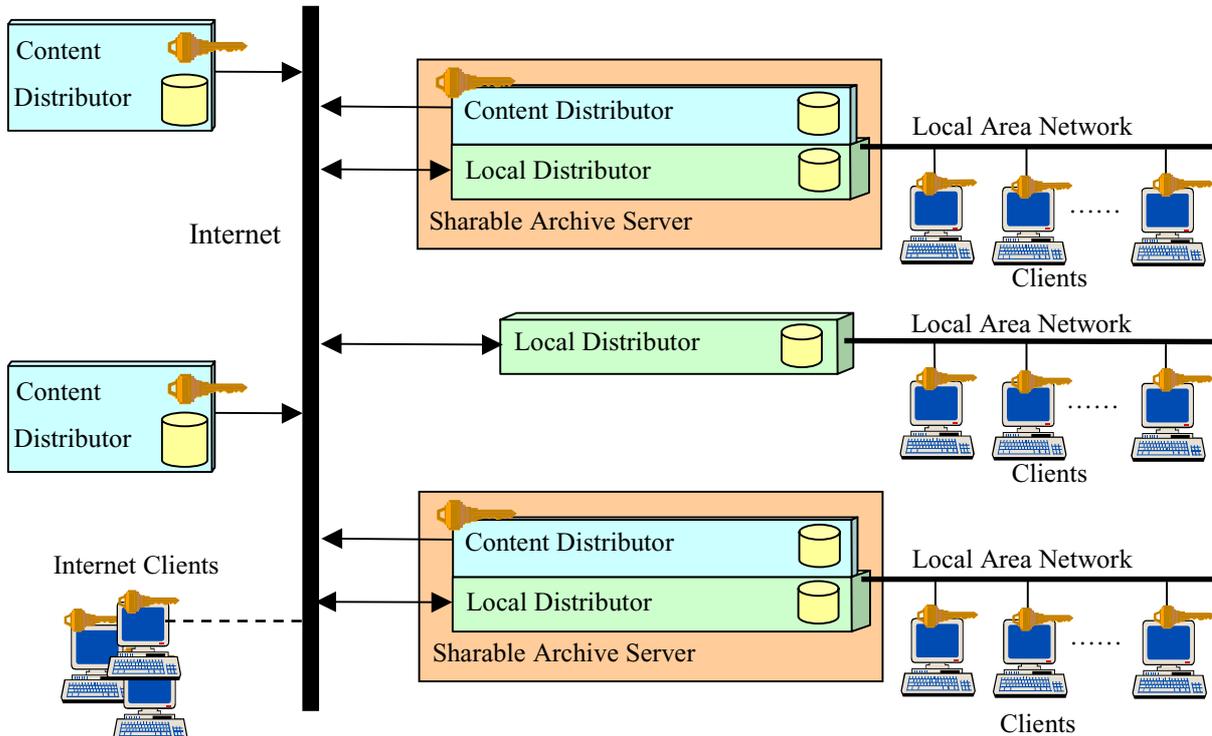


Fig.5 -- Sharing WEDELMUSIC Objects among Archives

In this case, they play the double role of Content Distributors and of Local Distributors. Such a practice allows to build networks of music content archives that share each other their content. In several cases, Content Distributors are also interested in becoming second publishers or re-distributors of contents acquired from another Content Distributor. In order to establish this service they need to have a LD. With the Local Distributor they may collect WEDELMUSIC objects from several Content Distributors and other LDs. In addition with the LD they can re-distribute the collected objects to their clients on their plant and to final clients on Internet. In Fig.5, the integrated Content Distributors and LDs are called Sharable Archive Server.

In the fig.5, the final clients (represented by the computer directly connected to Internet with a dashed line) may have a stable or a sporadic connection to Internet (for instance in the case of Mobile devices). The solution based on sharable archive server allows the implementation of a synergetic mechanism through which each archive may produce content that can be shared by others, thus enlarging the catalogue of the archive.

The above mentioned configurations can be reached incrementally according to the evolution and the needs of the industry or the corporate institution. The several solutions can be obtained by adding modules and modifying the al configuration.

Digital Right Management and functionality control

From the point of view of DRM, the WEDELMUSIC solution permits to trace the functionality exploited by clients. This feature is active only for the clients of the corporate institutions, for the other is not possible in absence of a direct connection and needs to be authorized by client for privacy issues. In each WEDELMUSIC object the list of functionalities that can be exploited for that object and their costs is directly included -- for some functionality the number of times that a given functionality can be exploited, can be also stated.

Only functionalities declared into the DRM rules can be exploited. When a functionality (in protected and non protected objects) is exploited a message is sent from the Client to the Local Distributor to get the authorization and to log the functionality performed. This feature is mainly limited to corporate clients. Clients directly connected via Internet may decide to permit the tracking of functionality or not.

The list of functionalities collected by the Local Distributor permits to perform statistical operations. They are very useful to understand the interest of clients in terms of functionalities, genres, authors, and music in general. In Fig.6, an example of the log file produced by the attendees of Arcipelago Musica Mediateque in Milan is reported. The

Mediateque of Arcipelago presents a WEDELMUSIC solution implementing a Sharable Archive Server. In the Mediateque they have 7 workstations for their clients while the Sharable Archive Server hosts both the Content and Local Distributors. Their music is mainly classical modern music: Molino, Schoenberg, Donatoni, Calligaris, Webern, etc. from the begin of the 1900 to this age.

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*** TIME=14:45:14      SESSID=12  HOST=user2  WDFID=A0010001P
WDFCID=A0011100004D  ACTION=OpenExt_Op  INFO=      PRICE=1.00 EURO
*** TIME=14:58:33      CLOSE SESSION      SESSID=12  HOST=user2
(131.175.228.245)     USER=test
*** TIME=15:23:00      SESSID=11  HOST=ntserver  WDFID=A0010001P
WDFCID=A0011100004D  ACTION=OpenExt_Op  INFO=      PRICE=0.00 EURO
*** TIME=15:30:47      SESSID=11  HOST=ntserver  WDFID=0002000ZU
WDFCID=0002000007R  ACTION=View_Op     INFO=      PRICE=0.20 EURO
*** TIME=15:31:03      SESSID=11  HOST=ntserver  WDFID=0002000ZU
WDFCID=00021100007Z  ACTION=OpenExt_Op  INFO=      PRICE=0.00 EURO
*** TIME=15:39:23      SESSID=11  HOST=ntserver  WDFID=0002000ZU
WDFCID=0002000007R  ACTION=View_Op     INFO=      PRICE=0.20 EURO
*** TIME=15:51:06      OPEN SESSION      SESSID=13  HOST=user4
(131.175.228.247)     USER=test
*** TIME=15:47:42      SESSID=13  HOST=user4  WDFID=00020003P
WDFCID=000211000007  ACTION=Execute_Op  INFO=      PRICE=0.00 EURO
*** TIME=15:49:01      SESSID=13  HOST=user4  WDFID=00020001E
WDFCID=000201000059  ACTION=View_Op     INFO=      PRICE=0.00 EURO
*** TIME=16:05:42      OPEN SESSION      SESSID=13  HOST=user4
(131.175.228.247)     USER=test

```

Fig.6 – Log of exploited functionalities

The log file of functionalities can be periodically requested from the Content Distributor to all its Local Distributors via Internet. In this case, the references to user name of the people working on the clients are removed for privacy reasons. This mechanism allows the Content Distributor to produce general statistics on the exploitation of functionalities on its music content. This information can be used in the business contract to define special agreements with Local Distributors. For example, the Content Distributor may be interested to have a fixed monthly rate for the usage of its music if the number of exploited functionalities is under a give threshold while the rate may change when the value is greater. As a limit case, the Content Distributor can be interested to prepare the bill according to the exploited functionalities.

4 REGISTRATION AND COLLECTING SOCIETY

According to the architecture reported in Fig.5, the above describe mechanism for tracking functionalities permits at the different actors involved in the architecture to perform statistics about the activities performed on redistributed and their WEDELMUSIC objects.

This process of collecting information can be performed by an independent institution as supposed in several transaction models. For example, in Fig.7, the general model is reported. In the figure, the Certified Organization (presently performed by WEDELMUSIC partners) is that permit the certification of Clients, Content Distributors and Local Distributors (see dashed arrows). This process is performed by using a protected connection and a tool that permits to make a link from the application and the computer hosting the application. This is performed by a

generator of a unique computer ID on basis of several hardware and software information of the computer itself, without the needs of using the CPU ID.

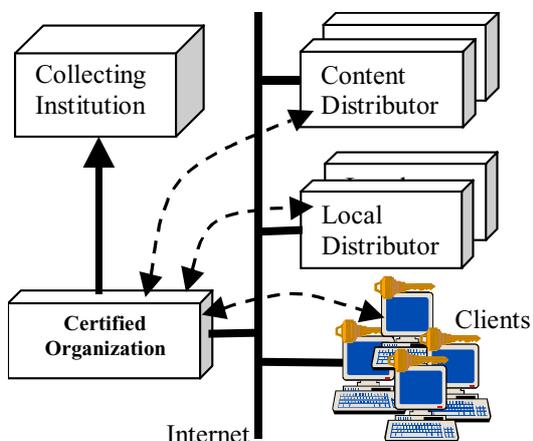


Fig.7 – General Certification and Collection model

The same organization or a different one (as currently performed by RIGEL partner of WEDELMUSIC) can collect the exploited functionalities from the Local and Content Distributors which are active on the network. This permits to make a service for the Collecting Societies which are focussed on tracking distributing right revenues, while they are capable of controlling the process at technical level.

5 CONCLUSIONS

In this paper, WEDELMUSIC solution for multimedia music distribution and sharing has been presented. It can be profitably used as a general solution for new applications of music distribution. Among these we can see: virtual music Mediateques, Internet exploitation of music, cooperative editing of music [3], production and adoption of multimedia digital object based on music, distance learning/tuition of music, etc. The experience presented in this paper is referred to the Music Mediateque of Arcipelago in Milan. It is the first trial of WEDELMUSIC architecture. From the first impressions, it has encountered the satisfaction of the end users and of the managers of the Mediateque.

6 ACKNOWLEDGMENT

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