Automating Production of Cross Media Content for Multi-channel Distribution

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Specification of Content Production and Distribution on Demand for Mobiles

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Abstract: This document is an outline of a document - Content Distribution Technology Market Analysis (CDA) that studies the Content Distribution Models available in the market today. This outline does not present the models; however, it presents the distribution process and covers some of the challenges Content Distribution solutions providers are facing. The Content Distribution Technology Market Analysis document is based on this outline and will present the Content Distribution Models.
Keyword List: distribution channel, mobile, adaptation, personalization, delivery

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Executive summary – Abstract

Content Distribution to mobile devices is an emerging topic in 2005 and will continue to grow very fast. There are several Content Distribution Models/Solutions that have been developed to handle the task of content provision.
This document is an ***outline*** of a document - Content Distribution Technology Market Analysis (CDA) that studies the Content Distribution Models available in the market today. This outline does not present the models; however, it presents the distribution process and covers some of the challenges Content Distribution solutions providers are facing. The Content Distribution Technology Market Analysis document is based on this outline and will present the Content Distribution Models.

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1. Introduction

Today's demand for multimedia content in mobile devices is growing very fast. The massive amounts of content and large variety of mobile devices make it very difficult to manage and distribute content for mobiles.

- Content Management and Distribution are hot topics in 2005. A variety of content distribution models have been developed to address this issue [3].
- A second topic that rises from content distribution is the optimization of content presentation. Due to the diversity of devices, a content item cannot be used in each device without a proper adaptation. Each content item should go through the right transformation process (transcoding) in order to be adjusted to the specific device. Those issues will be presented in the complete CDA document.
- A third and very important issue is content protection. Several DRM models are available to handle this task. An advanced approach to DRM is presented in a separate document - "Mobile DRM State-of- the-art", which reviews the available technologies on the market and determines the best DRM implementation in the world of mobile.

This outline will present the content distribution issues; the CDA document will present the Content Distribution Models and discuss the obstacles in establishing them. In addition, this outline states that rights protection (DRM) and content presentation optimization options are an essential part of the distribution process.

1.1. Problem definition

The CDA document will address the following problem:
"What are the Content Distribution Models available today to supply content to mobile devices? What are the obstacles in content provision? What are the available tools to improve content presentation and to protect it?"

1.2. Research/Document Structure

The research is an analysis of the technologies that are available in the market; it studies the process of providing content to mobile devices. It tackles the problems/obstacles of distributing content into these devices. The document starts with explaining the customers – the users who are using the content on their mobile devices. It continues with a short explanation of the media devices that will receive the content. The analysis progresses with a paragraph on the content that will be distributed to the devices. The following paragraph presents the Content Distribution process and some models will be presented. Next, the infrastructure and the networking are being forwarded. Last, some conclusions will be drawn and presented.

1.3. Scope of the Content Distribution Technology Market Analysis document

The document presents the following topics:

- The Content Distribution process
- The problems and obstacles of Content Distribution process
- Several Content Distribution Models to address the process

- Some content presentation optimization ideas

This document does not include the implantation of those technologies and does not include the Comverse solutions for *AXMEDIS*.

2. The Customers/Users

Mobile device users in 2005 are increasingly demand more content (entertainment, applicative and informative such as audio music, video, news, games, applications, text and multimedia) to be received into their wireless mobile devices. The customer of the content is any mobile device user.

In this document, we refer to customers as those users of mobile devices that would use content with/in their devices. Mobile device users can be segmented into many categories and groups, however, this segmentation is out of the scope of this document.
We consider the customers as the receivers of the content and the users of the content. The content requested by the users and the users' profiles are out of the scope of this document.

During the billing process, we can distinguish between two kinds of customers:

- Subscribers – those service providers' customers that are known within the systems and they can be charged for the content they receive.
- Shoppers – those customers that are purchasing content through a (web) shop.

The billing process is out of the scope of this analysis; we consider the billing processes and a "black box" that is done by 3rd parties.

3. The media/device

The media is the equipment that content will be distributed to. We consider the media as any wireless mobile device, which can be a mobile phone, smart phone or new generation PDA.
There is a large variety of different devices. There is a strong difficulty in distributing the same content to the different devices. This is one of the obstacles and challenges in distributing the content. The Content Distribution Models will have to handle and solve this issue.

4. The content

On the Internet, users typically navigate from page to page along Web links. In the last years we have experienced a massive growth in systems that can personalize content delivered to individual users (e.g. Amazon) [1].

The use of mobile devices to receive content is growing rapidly and we believe that personalization in mobile content distribution is the next stage in content provision to the individuals.

In field of mobile communication, issues such as personalization and harmonization play a major role and gain top priority due to presentation abilities and functionalities limitations of mobile devices. Limitations of mobile devices (such as screen size, quality & resolution) are key issues when distributing content. In addition, it is essential to use content filtering adapted to the target audience. All these will impact on the systems sizing and hardware used on the operator's sites.
Navigation and menu optimization are also role players – users would like to find the desired content with minimal navigation, there are solutions available to achieve that, those are discussed in the next paragraph.

4.1. Personalization

Content provision through the On-Line Store offers the potential of access to vital information anywhere at any time. However, hand-held devices with small screens connected to the web with slow and expensive network connections offer new challenges. In particular, it is difficult on such devices for a user to scan through long lists & menus. Services that can personalize information for the user based on the user's location, current task, and a profile of the user's interest can make the use of wireless web very attractive [9].
As in the web, personalized services (such as MyYahoo) that allow a user to select check boxes indicating interests, Mobile Content personalization can adapt such models and implement to enhance services. Using personalized content distribution tools (such as RegiSoft's PMCD) [2], Service providers and Cellular Operators can run efficient and profitable content services, managing multiple relationships with consumers and content providers through a single system.

Using personalized content distribution tools (such as RegiSoft's PMCD) [2], Service providers and Cellular Operators can run efficient and profitable content services, managing multiple relationships with customers and content providers through a single system.

Service providers and cellular operators can offer personalized content services that are absolutely spam-free. Customers subscribe to content channels via SMS, WAP or Web, specifying topics of their interest, the desired amount of content, format and delivery time. Filtering and personalization tools then select the most suitable items that are available in the system and distribute them to subscribers according to their personal preferences. Personalized content enables offering of timed delivery services (e.g. daily weather forecast at 7AM), content streaming, alerts or content on demand (pull). Through customized content delivery, service providers and operators can increase customer satisfaction and loyalty. A crucial condition is to disallow any spam-oriented systems to be developed for mobiles' content distribution.

4.1.1. Link Personalization

This strategy [1] involves selecting the links that are more relevant to the user, changing the original navigation space by reducing or improving the relationships between nodes.

The above approaches require constructing a user profile by the user. An alternative approach is to use artificial intelligence or statistical techniques to automatically construct a profile of the user interests. It is important that adaptive systems learn from a small number of examples and adapt quickly to changing user interests. To be truly useful in a mobile context, user interest must be inferred implicitly from the actions rather than requiring explicit ratings of content by the user. For example, the more a user reads of an e-mail message or news story, the more a user is interested in that story. Explicit feedback of user interest would require a user interface consuming screen real estate and additional transmission of data.

There are two basic approaches that may be used to infer profiles for making recommendations to users:

1. Collaborative filtering: monitors the behavior of all users and tries to find users with similar tastes. This approach requires many users to rate an item and users to rate many items before it can reliably make recommendations. Collaborative filtering is appropriate for personalizing location-based services such as restaurant recommendation on the web. However, it not appropriate to e-mail and unlikely to work well for changing events such as news delivery.
2. Content-based filtering: Content-based recommendation creates a statistical profile of the user's interests in terms of the words and phrases that distinguish items of interest to the user from other items. It is appropriate for news, e-mail and restaurant recommendation

The adaptive personalization approach with implicit feedback has two important advantages.

1. From a user's viewpoint, it is easier to use. The user just uses the system and a profile is automatically constructed.
2. It allows for additional content-based criteria to be used in determining which stories to send to a user.

Adaptive personalization is an important component of the mobile web. However, it is necessary to understand what is important to the user and use that to present the information [9].

4.2. Content Adaptation (Formatting/Transcoding)

During in the distribution process, the content item requires to go through an adaptation (transformation/transcoding) process before it is being sent to the mobile device. This transcoding process transforms the content according to the device capabilities (e.g. size, screen size, resolution, etc.). The solutions & tools for the transcoding process are discussed in section 7.2.

4.2.1. Menus optimization

In order to ease the use of menus for the user, and shorten the navigation in a menu, menus optimization techniques are used. Examples are item on the menus that appear

only if those are frequently used (such as start menu items in MS WinXP). This kind of technique will be used in content distribution to mobile devices as well.

4.3. Formatting/Transcoding

During in the distribution process, the content item requires to go through a transformation (transcoding) process before it is being sent to the mobile device. This transcoding process transforms the content according to the device capabilities (e.g. size, screen size, resolution, etc.). The solutions for the transcoding process will be discussed in this section.

4.4. DRM

The distribution of multimedia content such as music downloads and video clips demand a rights protection. Mobile entertainment companies have made significant progress towards providing users with a seamless Digital Rights Management (DRM) scheme that will allow content access anywhere, anytime, and on any device, the mobile enterprise has a long way to go. But in today's growing demand for mobile content, a much more strict approach to DRM needs adapting. DRM costs are likely to be considerably higher - but so is the payoff.

5. Content Distribution mechanisms

In today's emerging content era, there are many channels to supply content. The complexity of this task is very high due to the large diversity of content providers, mobile operators and mobile devices.
This section presents the distribution channels that are currently available in the market. There is a couple of distribution models that are used to charge the users. Those are covered in this section. In addition, the obstacles of distributing the content using these models are reviewed.

5.1. The generic distribution process (figure 1)

The generic distribution process can be described as follows:

- 1.0 Process initiation: A mobile user requests content from the Operator through one of the following channels with several user interfaces:

  SMS (1.1): the user sends an SMS to a specific location and receives a reply with the content or further instructions. This is called SMS Mobile Originated (SMS-MO)
  WEB (1.2): The user logs into a website (Operator's portal) and browses the catalogue for content options

  WAP (1.3): The user uses WAP on his mobile device to browse the catalogue

IVR (1.4): The user calls the Interactive Voice Response system and browses the catalogue. This is considered to be the most profitable way of content discovery and provisioning from mobile operator point of view.

Other (1.5): any other access request to content, e.g. rebranching, or providing access to the mobile content catalogue to 3rd parties interested in this services and/or to content providers.

- Content discovery (2.0): This is the process where the information regarding the UI is received and the catalogue (2.1) and the samples (2.2) are adapted to the right UI and the device. For example, a user accessing through the IVR will not receive the same catalogue as a user accessing through the Web. In many distribution models, the presentation of the catalogue and samples is adapted to the device at this stage. This can prevent the users from browsing the catalog for content that is not suitable to their specific device.

- Billing (3.0): When the user has selected the desired content, a process of billing and credit validation takes place. This is usually done by a 3rd party (or by the Operator's billing systems). There are two main models, the first is by credit collection – once the content had been sent to the user, the credit is charged, the second, is a Purchase, the users first completes the purchase and then the content is sent to the device.

- Adaptation and transformation (4.0) of content to the device capabilities: Information regarding the device is being collected and a transcoding process takes place to transform the content to the specific device. The right format of content is being selected to be sent to the device.

- Distribution (5.0): The content is sent to the device. There are several ways to implement the actual distribution that, the most common is by WAP push. A link to the device is sent and the users need to browse to the side and downloads the content.

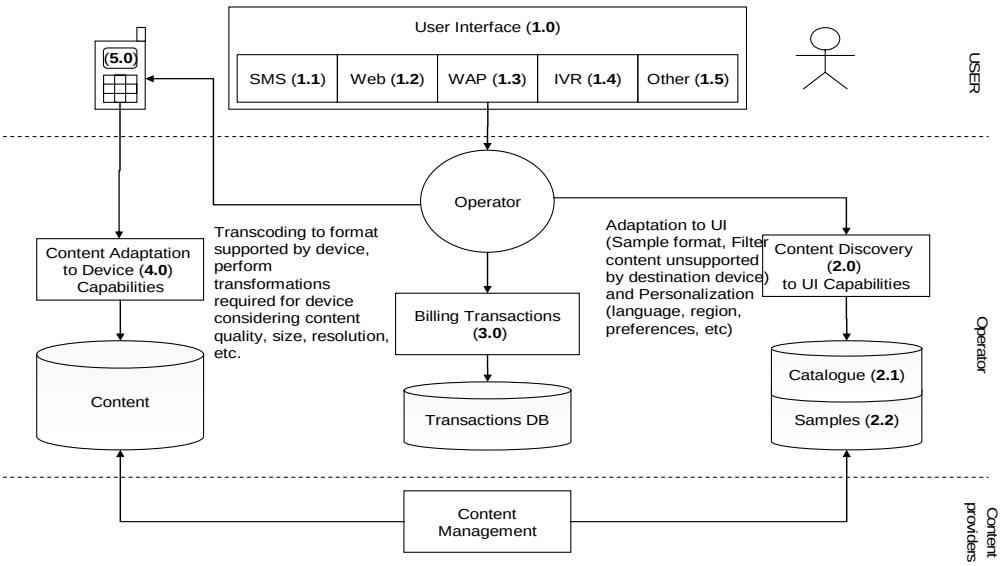

Figure 1

During this process there are many decisions that have to be made regarding the personalization of content:

- The presentation of catalogs & samples according to the UI
- The presentation of available content according to the device
- The Billing process.

All those decisions and personalization are dealt with the distribution models that are available today.

This complete CDA document will present here several distribution models that can handle the above described distribution process.

1. Content Distribution Solutions providers

All the above issues are dealt with the distribution models that are available today. The following section briefly presents several solutions that can handle the above described distribution process. Section 7 presents some specific solutions for the Content Distribution Process.

1.1. EMC Documentum (BEA & MobileAware)

EMC Documentum Content Management Solution, based on BEA WebLogic Service Delivery Platform, provides full content lifecycle management from submission and acquisition to cataloguing and verification, to publishing and eventual retirement of digital media.

The BEA WebLogic Service Delivery Solution is a platform enabling the creation, execution, and delivery of telecommunications services. The solution provides
Service creation and execution environments for composing enhanced services and delivering service bundles [10]. BEA WebLogic Platform provides the User Portal

framework for discovery of available content and the facilities to enable rapid integration with an operator's existing billing and messaging platforms.

MobileAware's Mobile Interaction Server (MIS) provides device recognition, optimal devise rendering of discovery portlets and maintenance of device profiles and the digital media formats they support.
MobileAware Fulfillment Manager provides delivery of downloadable content across a range of access channels by determining the appropriate download mechanism based on content type and target device and subsequently ensuring completion of the download itself.

The total EMC Solution [12] provides the creation & capture of Computer-generated documents (reports), Scanned images, enterprise applications, rich media, email discussions, Editorial Tools, Document Processing. It can manage Content Services and Extended Content Services such as XML, Content Intelligence, PDF Annotations, Content Transformations. It can then provide Content Distribution, Delivery and Archiving. The EMC solution uses the following architecture (figure 4) to provide its services.

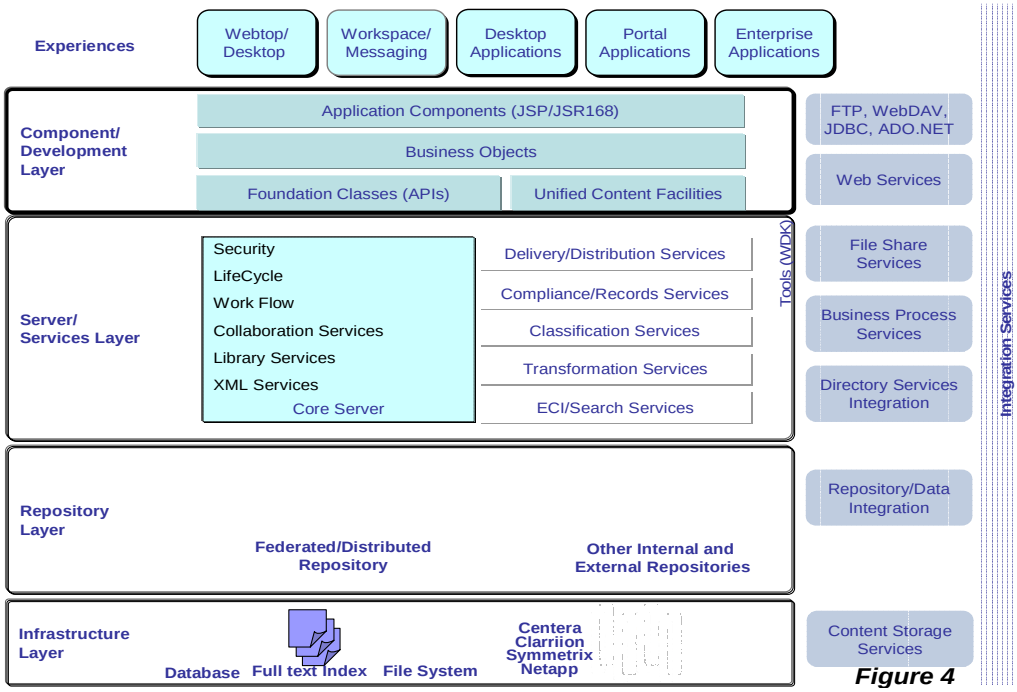

Figure 4

The Infrastructure layer provides the Content Storage Services, either in a database or file system. The content can be stores on the right storage device and automatically based on business policies.

The Repository Layer is responsible for replicating and distributing the desired content requested by the user. The right information about the user, the status and the object is fetched. The content object is replicated and is set ready for distribution.

The Server Service Level has two tasks, the first is to provide core services such as classifying and categorizing the object, searching and ranking capabilities, permissions and templates are available, thumbnails, annotations and PowerPoint

assembly is also available, history, audit trail and reporting. The second task is to provide Enterprise Content Integration Services such as Multi repository access in one search, Multi-lingual querying, and On-line translation of resulting content. Media Services such as Transforms content into device specific media formats encapsulates all rich-media capabilities. Content Intelligence Services such as Textual and semantical analysis Automatic folder classification.
Site Caching / Delivery Services – takes care of caching of the content and delivering it through the channels to its destination (portal server, reviewers and end users)

In the **Component Development Layer** there are few tasks: the APIs creates new objects and search for content in the content repository, assign security and ask for transformation, it also creates new business object frameworks.

In the **Tools and Web Development Kits** the import manager is capable of massively import large number of content assets at the same time, can check attributes and population, and assign Life cycle and Security.
The Business Process Services can take care of Outbound and Inbound integration and process workflow (i.e., External systems can invoke Documentum services and processes, Documentum process can invoke services in external systems), XML Message Processing, and it can also build and process a form.

The **User Experience Layer** is the User Interface of the document-, web content-knowledge-, and Collaboration- management**.**

It is very important to mention that EMC, BEA and MobileAware Platform is a very popular platform in the Mobile Content Delivery industry. It is know under the name “Mobile Content Delivery Solution” (MCDS).
Many companies have adapted this solution. An important joint venture of large solution architects such as **HP, Intel, Microsoft, & Incomit** have developed a Service Delivery Platform based on EMC/BEA platform.
The HP Mobile Service Delivery Platform (MSDP) is an integrated suite of software products and solutions from HP and its partners that enable mobile network operators to develop, deploy, deliver, and manage mobile voice and data e-services quickly and cost-effectively. The solution is easy for developers to create mobile applications using their existing software development environment – mostly based on Java or Microsoft tools.

1.2. Mobilitec - mPower

Mobilitec’s mPower Media Delivery solves carriers’ needs by offering service creation and management, of supported media formats and devices, integrated with existing carrier's infrastructure. According to Mobilitec, Mobile Content
Management deals with the following topics:

- Content Ingestion Management - Ingestion of all content types, with all its meta data and related content (e.g. previews), from all content providers
- Content Life Cycle Management - Handling the large volumes of content in an organized and effective way with tools for efficiency and consistency and management of the life-cycle of individual content items from submission, to publishing and activation, to deletion.

- Content Item Management (individual item) - Manage the complex structure of content items to support the multitude of file variations: different content versions over time, different files per devices, different languages for meta-data, etc.
- Content Workflow Management - Define, and dynamically update, specific workflows to be used to ingest, validate and publish content. Workflow control, workflow user permissions for actions in different steps.
- Live Content Management and Digital Rights (DRM) Management

Mobilitec mPower infrastructure can be seen in the figure below. It consists of the following components:
Submission: WEB Submission, Batch Submission, Integration with partners and content providers, mini portals
Content Management: Central and Local content management. Interfacing with & Providing Rating system. “Flavors” management & Marketing features
Discovery: interface with & Providing Rendering engine. Interface with & Providing Device management. Interface with & Providing Rating System
Purchasing: management of various purchasing options. Interface with / Providing Rating System. Comprising pages containing the purchase experience
Delivery: Delivery over various channels including: SMS, WAP, MMS Peer-to-peer, send to friend, recommendation and gifting, Push and Pull delivery.

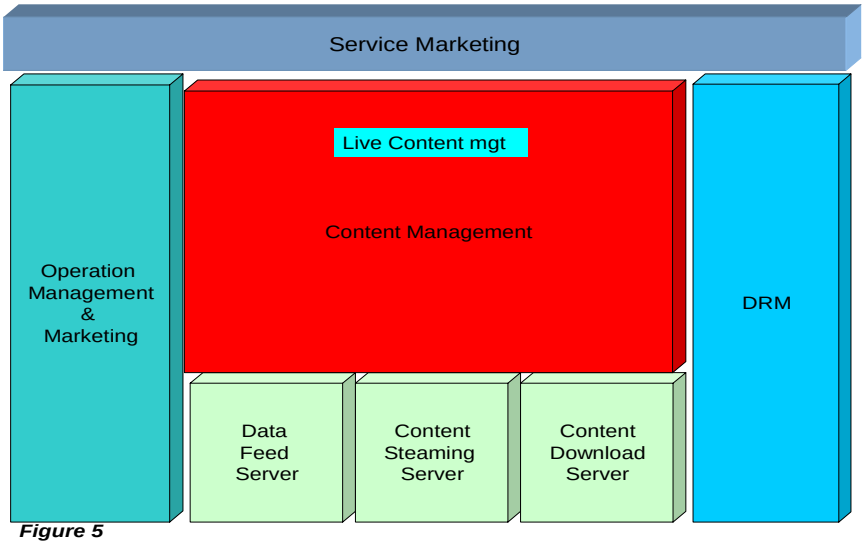

Figure 5

2. Specific Solutions for the Content Distribution Process

2.1. Content Discovery

Content Discovery is the process of understanding the changes (transcoding & transformations) that need to be made in order for the content to be adapted to the device capabilities.

A Mobile Content Delivery Solution (MCDS) is a joint solution from MobileAware, BEA Systems, and EMC Documentum [6]. It provides a framework for content download services within an operator environment (figure 5).

In this venture, BEA WebLogic Platform provides the User Portal framework for discovery of available content and the facilities to enable rapid integration with an operator's existing billing and messaging platforms [10].

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MobileAware's Mobile Interaction Server (MIS) provides device recognition, optimal devise rendering of discovery portlets and maintenance of device profiles and the digital media formats they support. In addition, MobileAware Fulfillment Manager provides delivery of downloadable content across a range of access channels by determining the appropriate download mechanism based on content type and target device and subsequently ensuring completion of the download itself [10].

The process provided by this solution separates Content Discovery/Delivery and Content Management. Content Discovery and Delivery takes place within the context of the User Portal environment where end-users access and utilize services and content offered by an operator. Content Management takes place within an operator's administrative environment where Content Providers work with the operator to manage the submission, approval, and publication of content to the User Portal environment.

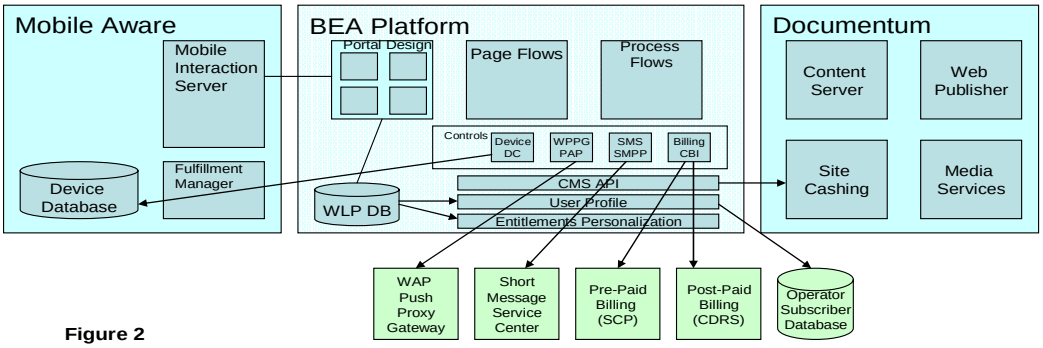


Figure 2

The individual content discovery portlets control the device-aware framework provided by the User Portal to ensure that only content appropriate for an end-user's device is presented as available for download. For example, polyphonic ringtones would only be shown in the discovery portlet when the end-user's device supports them. The discovery portlets also control the multi-channel device rendering functionality of the User Portal to ensure optimal presentation and user interaction with the portlet itself.

The Content Delivery integrated within the User Portal provides discovery portlets with additional generic capabilities that enable the content discovery process, including:

- An interface for querying and identifying available published content based on device characteristics, specific content formats, keywords, service association, etc.
- An interface that enables retrieval of pricing information to present to end-users
- The ability to initiate delivery of the content itself once discovery completes.

Content discovery portlets typically control the ability to query the published content to enable discovery of content in one of two ways:

1. End-users are presented with a series of menus and navigate their way through selected categories of content until they find a particular piece of content they are interested in. These menus are dynamically generated by the discovery portlet, ensuring the end-user is only presented with content choices that have been filtered based on the capabilities of the end-user's device. Menus of content can be organized and presented by category, by format, by popularity, etc.
2. End-users are presented with a 'search' capability, enabling them to initiate a keyword search and be presented with a list of available content matching the search criteria. Again, the content is filtered based on the capabilities of the end-user's device.

In fact, the user experience during content discovery may vary greatly depending on the implementation of individual discovery portlets, the desired business models employed by the operator and the capabilities provided by the operator's underlying network itself.

Some additional examples:

- End-users may only be offered the ability to discover content available for the device they are interacting with the portlet on, or they may also be able to indicate an alternative device they wish to discover content for (e.g. the end-user may access the discovery portlet from a PC browser and request content for delivery to their mobile device or PDA)
- End-users may be offered the ability to discover content for eventual delivery to another end-user e.g. send to a friend

2.2. Content Adaptation (Transcoding/Transformation)

Today there is a wide range of client devices in terms of both hardware and software capabilities. Device capabilities vary in different dimensions, including processing power, storage space, display resolution and color depth, media type handling, and much more. This variety on device capabilities makes it extremely difficult for the content providers to produce a content that is acceptable and appreciated by all the client devices, making application-level adaptation a necessity to cover the wide population of clients. The problem is even more challenging when multicasting the content to a large number of receivers with heterogeneous device capability and preferences.

It is important to mention that Transcoding abilities are present in about every platform that is available in the market. However, the implementation for specific transcoding codecs is not available. The platform supports the process and provides the infrastructure, but the actual codecs packages for implementation should be imported.

There are two main approaches for handling this diversity in content formats. These two approaches differ in the time when the different content variants are created to match the requested format.

- **Static content adaptation**

In static adaptation, the content creator generates and stores different variants of the same content on a content server, with each variant formatted for a certain device or class of devices. Static adaptation has three main advantages:

1. It is highly customized to specific classes of client devices
2. It does not require any runtime processing, so no delay is incurred,
3. The content creator has the full control on how the content is formatted and delivered to the client.

On the other hand, static adaptation has a number of disadvantages, mainly related to the management and maintenance of different variants of the same content

1. Different content formats need to be created for each sort of device or class of devices, and needs to be re-done when new devices are introduced
2. It requires large storage space to keep all variants of the same content.

- **Dynamic content adaptation**

With dynamic content adaptation, the content is trans-coded from one format to the other only when it is requested. Depending on the location where the trans-coding takes place, dynamic content adaptation technologies can be classified into three categories:

- **Server-based**

In the server-based approach, the content server is responsible for performing the trans-coding; the content provider has all the control on how the content is trans-coded and presented to the user.
Additionally, it allows the content to be trans-coded before it is encrypted, making it secure against malicious attacks. On the other hand, server-based adaptation does not scale properly for a large number of users and requires high-end content and delivery server to handle all requests.

- **Client-based**

In the client-based approach, the client does the trans-coding when it receives the content. The advantage of this approach is that the content can be adapted to match exactly to the characteristics of the client. But at the same time, client-based adaptation can be highly expensive in terms of bandwidth and computation power, especially for small devices with small computational power and slow network connectivity, with large volume of data might be wastefully delivered to the device to be dropped during trans-coding.

- **Proxy-based**

The proxy-based approach is where an intermediary computational entity can carry out content adaptation on the fly, on behalf of the server or client. Proxy adaptation has a number of benefits including leveraging the installed infrastructure and scaling properly with the number of clients. It also provides a clear separation between content creation and content adaptation. On the other hand, some content provider may argue that they prefer to control themselves how their content is presented to the user. Also, using proxies for adaptation does not allow the use of end-to-end security solutions.

- **Profiling (Based on the Generic Service Elements for distributed service platform)**

Another distributed service platform supporting adaptation of mobile services is developed based on the Generic Service Elements (GSE) approach [8]. This service platform takes a very practical approach to supporting adaptation functionality. The internal representation of context information, which includes the attributes for the adaptation support functionality, is based on simple profiling mechanisms implemented by the service platform. The adaptation support functionality of the service platform is divided into two different middleware services along the nature of adaptation. There are two kinds of context information that can be utilized in the adaptation of mobile services: static and dynamic context information. The static context information is considered stable within a short time frame, while the dynamic context information is changing dynamically all the time. Therefore, from the actual system point of view, two kinds of adaptation support are needed as well: static adaptation service and dynamic adaptation service. The static adaptation service provides the static context information in the form of profiles to be consulted by the services when needed. The dynamic adaptation service provides services to continuously monitor dynamically changing context. The service platform supporting adaptation must be able to provide services the attributes that are creating the need for adaptation. These attributes can be provided as context information. So, the service platform has to be able to sense and deliver the context information for the services utilizing it. In addition, the service platform has to be able to internally represent and process the context information it has sensed. The service platform utilizes profiling in its internal representation and processing of context information.

The profiles that the service platform uses for context information presentation include a user characteristics profile, user preferences profile, terminal profile and environment profile. The user characteristics profile describes user characteristics like age, name, and occupation that can be utilized for service personalization. The user preferences profile describes the user preferences towards the service domain and preferred service behavior in certain situation. It is based on defining the three identified preference variables for each profile. These variables are:

- Willingness - the user's willingness to use any service
- Disturbance – defines service behavior regarding allowed distractions that have direct effects on user surroundings (i.e. sounds)
- Interaction - defines the user's capability to be in interaction with any service.

A single preference profile defines these preference variables in a certain situation. For example, the values for the preference variables can be not, low, normal, and high. The user can define the preference profiles in addition to predefined ones. For example, if the user would define a sleep profile, he/she would probably set all preference variables to the value not. Then he/she wouldn't be disturbed by the system, and the system would not require any interaction because the user is not willing to use any service and not capable of interaction.

The terminal profile describes the current terminal capabilities that the user is using to access services. This information, like screen size and input method, is utilized to adapt the services to the user's terminal capabilities. The environment profile describes the dynamically changing context and can be used in the dynamic adaptation of mobile services to changes in the context. The environment profile includes information like network bandwidth, user body temperature, and noise level in the user surroundings. All the profiles presented so far can be implemented based on the same profiling

mechanism. So, the service platform provides a profiling mechanism that can be utilized for implementing these profiles.
The service platform also has to provide means for services to describe their interest regarding the context information, both static and dynamic. A technique called service profiling is provided for this purpose. The services can make a priori definitions of certain interesting contexts to service profiles. These service profiles are then registered with the service platform that sends an adaptation request to the service owning the profile when the current context adds up with the context defined in the service profile.

The adaptation strategy of the service platform belongs to the category of application-aware adaptation. Therefore the overall adaptation process is distributed partly to be the responsibility of the services and partly the responsibility of the service platform. Figure 3 presents the adaptation process as it takes place in the developed service platform and services utilizing it. The overall adaptation process presented in Figure 3 is explained along the bullets seen in figure 3 [8].

1. The service has been installed and it registers its service profiles with the service platform.
2. The dynamic adaptation process activates and starts with retrieving the profiles that contain dynamic context information. In the service platform there is only one profile containing dynamic context information - the environment profile.
3. The dynamic adaptation process continues with matching the dynamic context information in the profiles with the a priori contexts in service profiles.
4. Dynamic adaptation process sends an adaptation request to services owning service profiles that match the current dynamic context. The dynamic adaptation process returns to step 2 and continuously executes steps 2 to 4.
5. When the service receives an adaptation request, it can freely decide its actions. If the service instance exists, the service can adapt the service instance to a new context. The service can also change its logical behavior, adjust resource usage, perform a control action, or even discard the adaptation request.
6. The user is browsing the services to select the one he /she wishes to use and selects it.
7. At this point the profiles containing the static context information are retrieved. In the service platform, these profiles are terminal profile, user characteristics profile, and user preferences profile.
8. The static context information in profiles is taken into account in service instance creation. The service instance is created to best suit the static context.
9. When the service instance has been created it will be delivered to the user mobile terminal for execution.
10. Now the user is able to see the UI of the service and able to use the service. If the service receives an adaptation request it can adapt the service instance in use dynamically.
11. When the user doesn't want to use the service any more, he/she terminates the service instance.

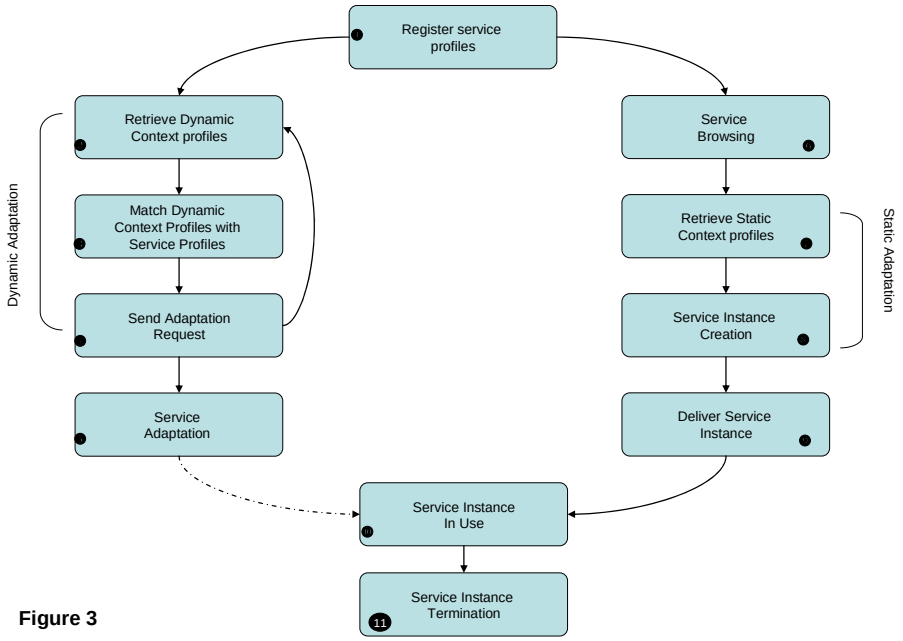


Figure 3

2.3. Content Delivery

The Content Delivery process in the MobileAware, BEA Systems, and EMC Documentum Framework [6] initiates once an end-user completes the content discovery process and confirms that delivery of the content should proceed. Delivery of the selected content depends largely on the type of content the end-user has requested, the capabilities of the end-user's device, as well as the manner in which the content has been discovered. For example, if discovery was completed using the same device that the content is to be delivered to, the content can be delivered directly within the same session by redirecting the end-user's browser or application manager to pull in the content. Alternatively, the content can be sent separately to the end-user's device using a mechanism such as WAP Push.

Within the MobileAware Content Delivery Solution [6], the Fulfillment Manager facilitates the content delivery process. It ensures the end-user requesting the download is authorized to download the content, determines the appropriate download mechanism to be used, based on the content and target device, and ensures completion of the download itself. It interfaces with the billing and statistical generation components to enable confirmation of billing. It also ensures tracking of downloads and handles installation reports devices, when appropriate.
The Fulfillment Manager facilitates delivery directly to the discovery device and also supports PC based discovery by enabling delivery to a device using WAP Push facilities available from the operator's network.

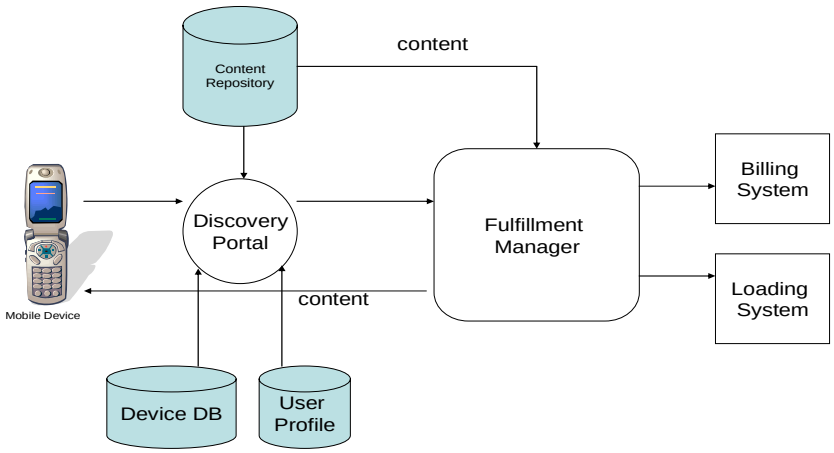


Figure 4

2.4. Billing

Another aspect of Content Distribution process is Billing. Although it is out of scope of this document, we will mention some issues. The billing process is usually done by a 3rd party solution. In the MobileAware Content Delivery Solution [6], the business logic within the Fulfillment Manager can be customized to align with operator business models (figure 4). For example, billing confirmation can occur prior to delivery of the content or can occur only following completion of the download. The business logic may also vary between pre-paid and post-paid subscribers.

2.5. Privacy – Content Protection – DRM

Architectures for the distribution and transport of digital content have become very strict. It is very important for a content provider and a major producer of devices for transferring and storing digital data to protect their data/content [7].
The distribution of multimedia content such as music downloads and video clips demand a rights protection. Mobile entertainment companies have made significant progress towards providing users with a seamless Digital Rights Management (DRM) scheme that will allow content access anywhere, anytime, and on any device, the mobile enterprise has a long way to go. But in today's growing demand for mobile content, a much stricter DRM approach needs adapting. DRM costs are likely to be considerably higher - but so is the payoff.

Because the context information can be private in nature, the profiling mechanism used for context information presentation used on the platform based on the GSE [8], must be able to guarantee the privacy of the user context information. The user should control the privacy level of context information. The privacy of user context information can be enforced if services are classified into trusted and not trusted services, trusted services having access to all context information and not trusted services having access only to public and not private context information. Therefore the service platform provides this kind of profiling mechanism and a query-based

service authentication process, through which the service can obtain the trusted status [8].

As mentioned above, a separate State-Of-The-Art DRM document is available and goes into much more details into this topic.

4. Content Provision Infrastructure/Networking

The increasing amount of information sent to mobile devices is multimedia, content-rich applications that require more band-width. There is a growing demand to provide new video-based applications quickly and efficiently to enhance productivity [4]. So the question becomes, how do you implement high-speed infrastructures while keeping bandwidth costs under control?
This section presents the networks that are available to distribute the content to the mobile devices.

2.6. Networking

3G brings together two powerful forces: wideband radio communications and IP-based services. Together, these lay the groundwork for advanced Mobile Internet services, including personalized portals, mobile commerce and unified messaging - encompassing high-speed data, superior quality voice and video and location-based services [13]. Making 3G a reality depends on technology developments in different areas. These include amendments to the radio interface to support wideband communications and in the core network. Supporting technologies, such as WAP and Bluetooth, also have an important role to play. This section provides a brief overview of some of the main technologies and developments involved [13].

- **GPRS**
  General Packet Radio Service (GPRS) is an enhancement to existing GSM and TDMA networks that introduces packet data transmission, enabling "always on" mobility. This means that users can choose to be permanently logged on to e-mail, Internet access and other services, but do not have to pay for these services unless sending or receiving information. When EDGE is added to GPRS, these data rates will increase up to 384kbit/s which is a step towards full 3G services.

- **UMTS**

  3G or third generation of mobile communication - UMTS is wideband wireless connectivity, which will usher in true convergence of technology. With data rates up to 2MBPS, UMTS seeks to build on and extend the capability of today's mobile, wireless and satellite technologies by providing increased capacity, data capability and far greater range of services using an innovative radio access scheme and an enhanced, evolving core network.

  UMTS allows extremely high bandwidth multimedia applications and m-commerce opening a New World of possibilities. From customized content, streaming video, video messaging to localized based services, UMTS offers a unique opportunity to create a market for highly personalized and truly unique mobility services.

- **WCDMA**
  Wideband Code Division Multiple Access (WCDMA) is a wideband radio technique that provides far higher data rates than other radio techniques available today, up to 2Mbit/s, and highly efficient use of radio spectrum. The higher bandwidth that WCDMA provides will deliver the full potential of 3G.
  WCDMA is fully compliant with IMT-2000 and is the air interface technology for standards in the 2GHz bandwidth, known as UMTS (Universal Mobile Telecommunication System) in Europe and ARIB (Association of Radio Industry Businesses) in Japan.

- **EDGE**
  Enhanced Data Rates for Global Evolution (EDGE) enables GSM and TDMA operators to offer 3G services using existing network frequencies. By making changes and additions to standardization of evolutionary phases of the air interface and the backbone networks, as well as the migration to ALL-IP and multimedia networks.

- **CDMA2000**
  cdma2000 is a decidedly efficient 3G standard for the delivery of high bandwidth data and high capacity voice services. The evolution of the cdma2000 standard will enable mobile systems to offer data throughputs of 2 Mbit/sec and beyond.
  cdma2000 is fully compliant with IMT-2000 requirements for 3G. cdma2000 will be implemented in the existing frequency bands of CMDA and TDMA at 800 and 1900 MHz, as well as in new spectrum at 2GHz in Japan.

- **WAP**
  Wireless Application Protocol (WAP) is a global, open standard that gives mobile users access to Internet services through handheld devices. It enables users to easily access a whole range of Mobile Internet and other data services from mobile devices such as smartphones and communicators, and without the need to plug into a separate laptop or data-enabled device.
  WAP enables this through a built-in “WAP microbrowser” that lets information be accessed direct from a phone, in the same way that web browsers provide access to on-line services via an Internet-ready PC. Typically, a WAP screen will display a number of hyperlinks to various services or information portals.

- **Peer-To-Peer**

  Peer-to-peer computing is a technology that uses the resources of many connected devices to distribute large content widely without the need for central servers. Up to now the successful peer-to-peer applications have been running on the fixed Internet, mainly on PCs. But as mobile phones and other small devices are gaining computing power, the question is how the peer-to-peer activities could be scaled down to such devices. Nokia is one of the companies which had studied how the peer-to-peer activities could be scaled down to mobile phones and other small devices [5].

3. Content Provision Infrastructure/Networking

The increasing amount of information sent to mobile devices is multimedia, content-rich applications that require more band-width. There is a growing demand to provide new video-based applications quickly and efficiently to enhance productivity [4]. So the question becomes, how do you implement high-speed infrastructures while keeping bandwidth costs under control?
This section will present the networking issues that will be required to distribute the content to the mobile devices.

- Bandwidth –G2, G3 – Networking issues and bandwidth will be described.

- Peer-To-Peer

Nokia is one of the companies which has studied how the peer-to-peer activities (computing technology that uses the resources of many connected devices to either distribute large computing tasks or distribute content widely without the need for central servers), up to now the running on the fixed Internet, mainly on PCs, could be scaled down to mobile phones and other small devices [5].

4. Introduction on DRM

Digital Rights Management (DRM) is the ability of a computerized system to manage and protect the Intellectual Property Rights (IPR) of content providers. This, essentially means, keeping track of what rights are owned by content providers, what rights they have granted (or sold) to access media, and prevention of access to the media without obtaining rights. This field has been around for several years in the world of PC's and made headlines from various phenomena in the world of Digital Music and Video.

Many in the mobile telephony world see the access to content (that is either downloaded by a user, sent in messages, or broadcast to a mobile terminal) as being one of the "killer applications" of the 3G and 4G world. However, before this level can be achieved there is the need to address the needs of the content producers for protection and reimbursement for their content.

In the world of the wired internet and personal computers the problems of DRM is being addressed by many different organizations – both commercial, e.g., Microsoft, Real, Apple Computer, and in standards, e.g., W3C, ODRL. Most of the solutions that are being offered for the PC world involve different levels of defensive protection and incentives to "act properly", i.e. purchase rights to access the media.

When translated to the "mobile" world, many of the companies involved have been addressing a small sector – that of mobile music players, e.g. iPod or Creative. Therefore, many of the commercial solutions offered today address the need for protection of music/audio media (see the discussion below of the Microsoft solution). Such commercial (and usually proprietary) solutions are available from companies such as Microsoft, Real, Chaoticom, and Apple, and many of them give only limited rights management.

Evolution of Mobile DRM

As mentioned above, there are several forces involved in the evolution of DRM for the mobile market (beyond the mobile music players mentioned above). These include the content producers, content providers, mobile operators, and the mobile users (that want access to the media). As a result, there is a need for the development of an interoperable solution that will provide an end-to-end solution that will satisfy all of these players and work for all of them.

The evolution of Mobile DRM has been rapid. Its introduction and acceptance in the mobile and content world is quite remarkable. The successful introduction of Mobile DRM can be attributed to the exceptional collaboration between all parties in the mobile-content value chain. The framework for the joint effort for drafting specifications for interoperable Mobile DRM was provided by the Open Mobile Alliance (OMA) – an alliance of about 400 companies driving standards in the mobile world. The result was OMA DRM 1.0 which was released in November 2002.

This was the first DRM standard designed especially for the mobile world, by the mobile companies, taking mobile requirements and objectives into consideration. To understand the limited functionality of this first version, however, it is important to understand the mobile content market that existed at this time. Most mobile operators had joined the content business selling light media like ringtones, logos, wallpapers and simple games. This content was created specifically for mobile devices and mainly under the control of the mobile operator, eliminating the portability of content across devices almost entirely. In addition, most of the content was of low value, so even an imperfect solution to rights protection was acceptable. Thus the demands from Mobile DRM were relatively easy to meet, and these were addressed by OMA DRM 1.0.

As the mobile industry looks forward, however, there is the hope for broader content-based services that will breach the "walled garden" nature of these earlier services and that will involve not only the mobile operators and not only media that is designed for mobile handsets. This was the impetus behind the expansion of the OMA specifications to DRM 2.0.

It is important to remember, however, that not all of the mobile DRM world is OMA compliant. Several companies like Microsoft, Real, SDC, Chaoticom and even Apple's iTunes offer proprietary DRM solutions for mobile. Most proprietary DRM solutions are not up to the competition with OMA DRM as the latter is being pushed and actively supported by all parties in the mobile-content value chain - content owners, distributors, mobile operators, mobile manufacturers and IT companies. As a result many of these proprietary solutions are planning to adopt parts of the OMA solution in their future releases.

Two strong players in this market remain – Microsoft and SDC. Microsoft, who sees itself making strong in-roads into the mobile market with its PocketPC PDAs and the SmartPhone platform is developing their Windows Media DRM solution for Mobile Devices. SDC, a Swiss company that holds patents for essential parts of Mobile DRM, is marketing a Java based, multi-device solution that works on many platforms already and is "going live" in many operators offerings in the near future.

The remainder of this paper presents a summary of these solutions for Mobile DRM, looking at what is offered by the two OMA versions and the proprietary solutions from Microsoft and SDC. Another aspect that should still be examined are the solutions that are being offered to the content providers, from companies such as NDS, Beep Science, etc.

Another note is that Mobile DRM is, to a certain extent, derivative of the broader topic of computer based DRM. The mobile solutions to a great extent limit themselves due to limited capabilities of the mobile handsets and therefore many of the available solutions for DRM that exist may not be compatible with this limited market.

Basic concepts

DRM defines the following basic concepts that are necessary to understand each of the technologies described below:

- **Protected content –** the actual content that is protected by some contractual agreement between the content provider and the content consumer. This content may be transferred either by direct download, as part of a message (e.g. MMS or email) – both initiated by the provider or the consumer. For protection of the content the data will be encrypted and can be decrypted only with the key that is provided as part of the Rights Object.
- **Rights Object (RO) –** a file that provides the content decryption key as well as describes the rights assigned by the content provider to the consumer relative to the protected content. This may also be referred to as the "License Key".
- **Rights Expression Language (REL) –** the syntax and semantics of the RO. This language includes all of the different types of permissions and their parameters that can be assigned to a content.
- **Content Provider (CP) –** the producer of the media and the owner of the rights to the media.
- **Content Issuer (CI) -** the body that actually distributes the content, this may be same as the Content Provider.
- **Rights Issuer (RI) –** the body that generates and provides the Rights Object for a protected content.
- **DRM Agent –** the application on the terminal that retrieves the DRM protected media and manages the permissions for access to the media.

Common DRM Process

All DRM technologies try to cover the following process steps when protected content is retrieved by a recipient and "played" as a local file –

1. **Content packaging** – Content is encrypted and packaged into a known format that may include header information that describes the actual content. It is advisable that any content adaptation be performed prior to encryption. This step will typically be performed by either the CP or CI.
2. **Distribution** – This includes making the content available through download from a CI web-site, distributed on some hard media (e.g. a CD) to customers, sent as an attachment to a message, or placed on a media server for streaming to a recipient.
3. **Recipient authentication** – The recipient client is authenticated using standard authentication methods. This step guarantees the existence of a trust relationship between the recipient and the CP.
4. **Rights Object generation** – The RO for the specific content and use that is being licensed is generated as additional content that must be used in conjunction with the acquired content in order to "play" the acquired content.

5. **Playing the protected content** – The recipient can now use the media content according to the license described in the RO. This step may include the use of some "metering" mechanism when the rights granted are limited, e.g., "media can be played M number of times".

OMA DRM 1.0

As mentioned, in the Introduction, this was the initial specification for digital rights management for the mobile environment. The goal was to address the immediate needs of the mobile operators that were distributing simple content for limited use by their customers, mostly ringtones and wallpaper. The limited nature and the urgency in which this set of specifications were produced influenced certain of the concepts that were included in this specification.

Supported functionality

OMA DRM 1.0 supports the following functionality:

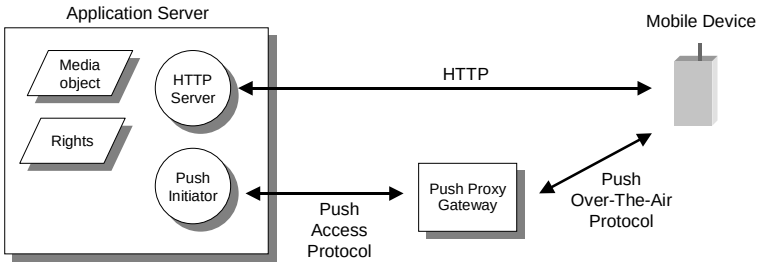
- Creation of a Rights Object that describes the limitations on the use of the protected content. The RO is usually tailored to the protected media and to the recipient device.
- Forward Lock – preventing a recipient from transferring protected content to other recipient users or terminals.
- Separate delivery of the content and the rights object.
- Combined delivery of the content together with the associated rights object.

This basic functionality allows a user to download (or receive) content that is encrypted, either together with a RO [Combined Delivery] or to be required to contact the RI to obtain the RO for a previously received media file [Separate Delivery]. This scheme allows for the different use-cases that are prevalent in the mobile community –

- Combined delivery could be used to allow a user to "sample" some media – hear a song once and decide if he wants to purchase the rights. At time of purchase the user would contact the rights issuer who could then generate the proper RO for the rights being purchased.
- When downloading a media file the operator could supply the RO that would allow the user to use the media on his handset, but prevent him from distributing the content to other users that have not purchased the rights [Forward Lock]

Architecture

The following diagram appears in the OMA DRM 1.0 specification and shows the relationships between the Application Server that is acting as both the CI and RI, using and HTTP interface. The Mobile Device, that includes the DRM Agent, can either retrieve the Combined object directly over HTTP or request the Separately delivered RO that will be pushed to the device using the OMA-Push protocols.



Expression Language

The OMA Rights Expression Language (REL) is based on the Open Digital Rights Language (ODRL), an open standard developed by W3C. This is an XML based language that allows the specification of the rights granted and the parameters for each of the rights options.

The goals of this first version of the REL were to define a simple and light-weight means of expressing a basic set of permissions. This version does not have the features for controlling distribution of the protected media nor the device-management (e.g. install or uninstall).

The basic structure of the RO is a hierarchy of elements in REL, with the root element being the "Foundation Model" that includes two child-elements the "Context Model" that defines the identification information for the version of the RO and the "Agreement Model" that specifies the rights that are granted. There will be a separate Agreement Model for each controlled media. Each Agreement Model includes two or three children the "Asset Model" that identifies the controlled media and the "Permissions Model" that qualifies what rights are granted, and possibly the "Security Model" that controls the security and encryption aspects (i.e. including the decryption key). The Permission Model may contain a "Constraint Model" that limits the permissions.

The types of permissions that are included in this version of the REL are – "play", "display", "execute", and "print". The constraints that may be placed on the permissions are either a limitation of number of times or constrained within certain dates (e.g. expiration on 4 July).

The rights object is encoded as a binary WBXML file and may also be encrypted for further protection.

Target Devices and Supported Platforms

www.openmobilealliance.org/docs/OMA-BOD-2004-0078R01-Product-examples-on-DRM-1.0.pdf OMA has a report that is available at – This document lists close to 200 devices that support DRM 1.0, although most of the models listed claim to only support the Forward Lock feature of the specifications, with only a small number of Nokia and SonyEricsson models supporting Combined and Separate Delivery. In addition, they also list a large number of application providers that claim to support all of the DRM functionality for the content that they produce.

It should also be noted that MMS 1.2 compliant clients and servers should support Forward Lock and MMS 1.3 implementations should support all of the appropriate features of DRM 1.0.

Available Tools

OMA is dedicated to creating specifications for interoperable implementations and therefore creates the resources necessary for verification of the interoperable nature of the compliant implementations. These resources include the Enabler Test Plan and the organization of Test Fests, where implementers are invited to test their implementations for interoperability with other implementations.

Licensing/Patents

Part of the OMA membership agreement includes the declaration of relevant IPR owned by members and the granting of rights to use of this IPR. The complete list of declared IPR is available from the OMA Website. OMA is not responsible for any licensing agreements between the holder of the patent/license and licensees.
MPEG-LA, an independent organization that represents groups of patent holders, has gathered a consortium of DRM Patent owners – including Matsushita, Sony, and Philips. They have published terms for use of essential IPR for OMA DRM 1.0 & 2.0 that include licensing fees per terminal and per user. More information can be obtained from their website . It should be noted that, GSMA has advised its membership to refrain www.mpegla.com– from using OMA DRM until the issues of licensing have been resolved.

OMA DRM 2.0

- The second version of the OMA DRM specifications both expanded on the feature set, while also downgrading one of the central features of DRM 1.0 – Forward Lock. The use cases that were considered for this release pointed to two major features that needed to be supported –Users that wished to purchase rights to media that could be used on different terminals, e.g., his handset, MP3 player, PC.
- Superdistribution – a user who wishes to spread a media file to many recipients – needed to be encouraged.

Supported functionality

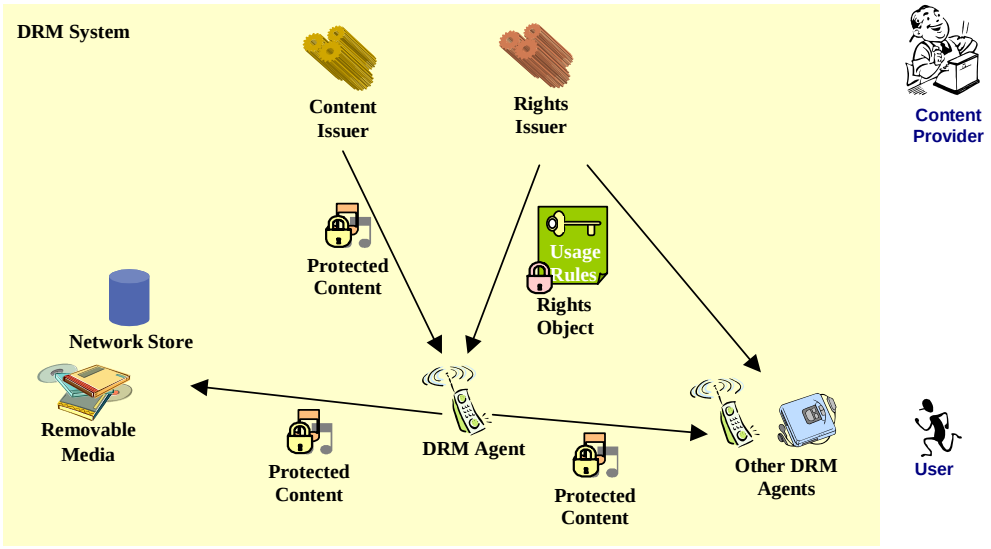
This second version supports the following features –

- Combined and Separate Delivery of the media and the RO – similar to DRM 1.0
- Definition of “Domain” – allows a recipient to define a set of devices to be part of a domain. The RO will then be generated to allow the use of the media on any of the devices within the domain, without the need to acquire a new RO.
- Ability to backup the protected content without need of acquiring a new RO.
- Support for streaming of protected media to the recipient terminal
- Superdistribution – allows a user to forward protected media to other recipients. These “second-stage” recipients will be directed to the RI (through links in the protected content) to obtain an appropriate RO in order to access the media.
- Support of connectivity to DRM Systems that are not OMA DRM compliant

Other changes in the specifications in the new version include a more complete specification of the encryption format for the protected content as well as the specification of the Rights Object Access Protocol (ROAP).

Architecture

The following diagram shows the conceptual architecture of the DRM system as defined in OMA DRM 2.0



Expression Language

The v2.0 REL is an extension of the v1.0 specification. Therefore the language is still based on ODRL and the basic structure remains as described above.

There are differences however –

1. There is a new "Inheritance Model" that supports a one-generation inheritance of permissions and constraints. This allows the specification to support content that is downloaded as part of a subscription to content.
2. There is a new constraint element that supports permissions to be constrained to a particular individual. Allowing a user to use the protected media on any device that can identify him to the DRM Agent.
3. A single agreement can be designated for many media objects.
4. There are new constraints to support limiting the amount of time that a media object is used. Not only the distinct number of times, but also the total length of time that it is used.
5. There is a new permission for "export" that allows a user to send the media to an non-OMA compliant DRM system

Target Devices and Supported Platforms

There are currently no mobile devices that support the OMA DRM 2.0 specification, however, these are expected to be available at the end of 2005. SDC (see below) has plans to release their Java Client with DRM 2.0 support in Nov, 2005. Content provider systems from

several companies, including Beep Science, NDS, and Discretix, have announced plans to have systems available in Q4, 2005.

Available Tools

OMA is dedicated to creating specifications for interoperable implementations and therefore creates the resources necessary for verification of the interoperable nature of the compliant implementations. These resources include the Enabler Test Plan and the organization of Test Fests, where implementers are invited to test their implementations for interoperability with other implementations.

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MPEG-LA, an independent organization that represents groups of patent holders, has gathered a consortium of DRM Patent owners – including Matsushita, Sony, and Philips. They have published terms for use of essential IPR for OMA DRM 1.0 & 2.0 that include licensing fees per terminal and per user. More information can be obtained from their website – www.mpegla.com.

Microsoft DRM

Several proprietary commercial DRM solutions exist for the mobile world; many of these are not predicted to continue once the OMA standards begin to show-up. One representative is the Microsoft Windows Media Rights Manager.

Windows Media for DRM 10 is split into several levels of support for different types of devices. The following description is relevant for their "Portable Device" support. It should be noted that at the present this are of protection is available for "audio" media, therefore there is a limit on the type of operations that could be supported.

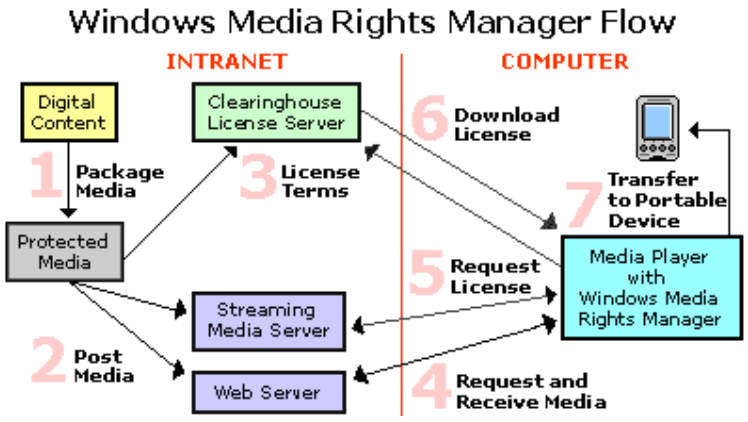
Supported functionality

As noted above – Windows Media DRM (WMDRM) for Portable Devices supports audio content.
Similar to the OMA Standards, WMDRM supports both combined and separate delivery of the RO [that MS terms the "License"] and the protected media. In addition, there is support for streaming the data to the portable device under license protection.
To support subscription services an inheritance mechanism (called "chaining" by MS) is supported.

The MS Solution is very tightly bound with other MS Windows components in the user's device. For example, the application that saves the licenses and checks their validity is the Windows Media Player, that identifies if a valid license for the protected media is available, and if not, connects the device to the RI to allow the user to obtain a valid license. The Media Player is also equipped with the proper metering tools and clocks to verify that the recipient has not exceeded the constraints specified in the license.

Architecture

The following diagram shows the different flows of obtaining the protected media and the License to play the audio from a Portable Device.



Expression Language

The exact format of the Expression Language is not publicly available and the features for the Portable Device area is limited to support of the following features –

- The only permission allowed for the portable audio is "AllowPlay"

- This permission can be constrained either by a count of plays or by a date range (there is an ability to invalidate the license if the user changes the dates in order to extend the license!)

Target Devices and Supported Platforms

Microsoft lists various partners that provide different aspects of support for Windows Media DRM. These include mainly content providers and licensing clearing-houses, but there are various companies listed as supporting the system in their chipsets for portable and network devices. Recently, Philips has joined the list of chipset producers that has committed to supporting DRM 10.

Available Tools

Microsoft provides a SDK that allows application writers to incorporate the different aspects of the DRM solution in their applications. The SDK includes tools to –

- Encrypt Windows Media files
- Generate secure business rules
- Produce the License Files
- Add the tools needed to a media player to support the control aspects of playing the media.

Licensing/Patents

Licensing must be purchased from Microsoft.

Secure Digital Content (SDC) ag Java Solution

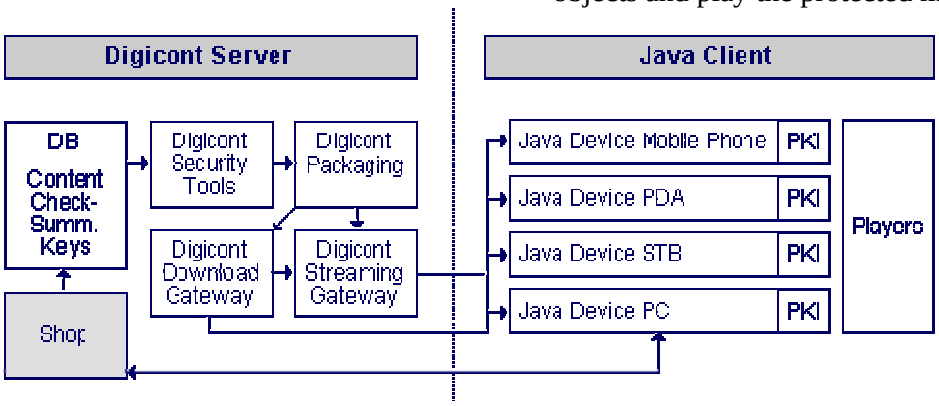
SDC is a Swiss company established in 1998 that claims to own the patent for the first DRM solution for digital music downloads, that was filed by its founder Rolf Brugger. It has produced a system that is implemented in Java and therefore, according to their claims, does not need any installation of the client on the portable device – just the Java Virtual Machine.

Supported functionality

SDC has a product that provides a full range of support for mobile rights management that includes encryption of content, device authentication, combined and separate delivery, support for super-distribution. This is a multi-device solution that allows a user to copy the protected media between different devices, all under the protection of the same RO.

Architecture

The following diagram describes the connections used by the solution to transfer the rights objects and play the protected media:



Expression language

The SDC solution uses a OMA 1.0 compatible REL with added features for "Secure Superdistribution" and "Secure Content Transfer". These additional features have been added into OMA DRM 2.0.

Target devices and Platforms

SDC has systems running with Vodafone Live! and Cegetel (SFR). Part of the claim of the system is that there is no need for an embedded client on the devices – just the Java Virtual Machine. Therefore, any Symbian device, Series 60, or other handset that supports Java clients can support the DRM system.

5. Conclusions & Implementation

The demand for Mobile Content Distribution is growing very rapidly. With the fast developing mobile devices and delivery channels, provision of rich content opportunities will advance. Handheld devices' capabilities are developing very fast

and soon will be able to receive any type of rich content. The networking capabilities are rapidly growing and will be able to reach high speeds in the coming years.
The challenges for the Content Distribution Solutions industry will lie less in the network & devices capabilities, but will still have to face the non-standardized world of content provision & protection.
One challenge for the content distribution industry is the massive diversity of devices, with no delivery standards, is the greatest task of this moment. The content discovery process will stay the most time consuming as long as there are no standards.
Another challenge for the content industry is content protection. While the demand for content is growing, content protection and rights management are becoming even more important task in the content distribution process. Content Delivery parties have to guarantee to content producers and owners that content protection is an essential condition in the delivery process.
We believe that the above mentioned challenges will remain very important in the coming years and consume most of the resources while the technology of content delivery will advance and ease the distribution process. The key to success is to get the mobile industry to adapt some standardization schemes and follow those in the Content Distribution process.

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6. Acronyms

- DRM – Digital Rights Management
- CDA - Content Distribution Technology Market Analysis
- PDA – Personal Digital Assistant
- SMS – Short Messages Service
- SMS- MO - Short Messages Service - Mobile Originated
- IVR - Interactive Voice Response
- UI – User Interface
- GSE – Generic Service Elements
- MCDS - Mobile Content Delivery Solution
- MIS - Mobile Interaction Server
- MSDP - Mobile Service Delivery Platform