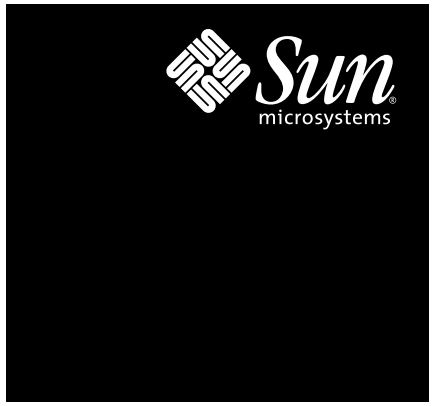
Open Standards-Based Mobile Music Architectures for Wireless Carriers

A Technical White Paper
February 2005

Bruce Baikie
Steve Gaede
Greg Wolff



© 2005 Sun Microsystems, Inc., 4150 Network Circle, Santa Clara, CA 95054 USA

All rights reserved.

Sun Microsystems, Inc. has intellectual property rights relating to technology embodied in the product that is described in this document. In particular, and without limitation, these intellectual property rights may include one or more of the U.S. patents listed at http://www.sun.com/patents and one or more additional patents or pending patent applications in the U.S. and in other countries.

This distribution may include materials developed by third parties. Sun, Sun Microsystems, the Sun logo, Java, J2ME, J2EE, iForce, Solaris, StorEdge, “Write Once, Run Anywhere,” and “The Network is the Computer” are trademarks or registered trademarks of Sun Microsystems, Inc. in the U.S. and other countries.

All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the U.S. and other countries. Products bearing SPARC trademarks are based upon architecture developed by Sun Microsystems, Inc.

UNIX is a registered trademark in the U.S. and other countries, exclusively licensed through X/Open Company, Ltd.The Adobe. logo is a registered trademark of Adobe Systems, Incorporated.

Please
Recycle

Table of Contents

Chapter 1
Introduction

The amazing success of Apple's iPod music player has caught the eye of industry observers and consumers alike. It signals a new level of cooperation between the music and the electronics industries, with alliances that have made legal music downloading a reality. For consumers, the iPod has been a 'must have' accessory for playing digital music anytime, anywhere.

But the iPod music player is useful only to those with Apple Macintosh or IBM PC-compatible computers and high-speed Internet connections. As large as that potential customer base is, it is dwarfed by the number of subscribers with mobile phones. Whereas Apple has sold 10 million iPods to date ("Apple's Profit Quadruples, Thanks to iPod," *New York Times*, January 13, 2005), Gartner estimates mobile phone sales to be 560 million in 2004 alone ("Downloads to cellphones sidestep music players," *www.iht.com*, December 23 2004). Clearly, if only a small fraction of future mobile phones are equipped for music download and storage, this market could quickly eclipse the successes of Apple's iTunes Music Store. Indeed, if the Taiwan-based Industrial Economics and Knowledge Center's prediction is correct, demand for mobile phones with built-in MP3 players will reach 350 million units by 2008 ("Mobile phones with built-in MP3 players to become mainstream by 2008", www.*phonecontent.com*, September 20, 2004). This fact is not lost on wireless carriers and handset manufacturers, who are scrambling to have digital music-capable phones and digital-music downloading services ready to compete with a much-anticipated offering from Apple and Motorola. For example, in November 2004, Korea's SK Telecom rolled out Melon, the first online music store run by a wireless carrier, differentiating themselves from those that re-brand other music services.

Wireless carriers understand that mobile music isn't just an adjunct, it's a whole new market that can reach subscribers in developing countries without basic Internet access, in developed countries with a highly-mobile population, and teenagers who may impulse buy the latest hits wherever they happen to be. If the success that wireless carriers have had with ringtones offers any indication as to the potential size of the mobile music market, carriers stand to profit handsomely. As reported by CNET News ("Cell phones take iPod challenge," November 12 2004), an estimated USD $4.1 billion was spent on ring tones and ring tunes in 2003. This amounts to more than 20 times the estimated $200 million generated by Apple's iTunes Music Store since its opening ("Get Ready to Call iTunes," *www.forbes.com*, December 6 2004). No wonder that Billboard Magazine lists the top ring tones in its popularity ratings!

Converging Factors

A constellation of factors are converging to make the mobile music market one that's ready to blossom:

- Mobile phones with music storage and playback capabilities are now becoming available, enabled by small, high-capacity Flash memory devices and micro-disk drives.

- The music industry is becoming satisfied that their copyrights can be protected adequately through Digital-Rights Management (DRM) standards and technology.
- High-speed Internet Protocol (IP) networking is being rolled out by wireless carriers worldwide using digital 3G cellular networks.
- The Java™ 2 Platform, Micro Edition (J2ME™) platform has become a standard feature of mobile phones, allowing compelling and innovative applications to be developed that sell and play digital music in a device-independent environment.

Cost-Effective Infrastructure

Wireless carriers are eager to profit from the bandwidth they have purchased in order to deploy their digital 3G networks, but they must be cautious not to price music downloads so high that their customers choose traditional Internet music stores and stand-alone music players instead. Carriers may not be able to sell music at the same $2-3 per-item rates they are able to charge for ringtones, and having the flexibility to adjust prices to compete aggressively depends on having a cost-effective, scalable, and flexible mobile music infrastructure.

That's where solutions from Sun Microsystems come into play. Sun has a long history of delivering carrier-grade storage, servers, and software to telephone companies worldwide, and they have developed products and solutions specifically with today's wireless carriers in mind. With its long-held belief that every computer should be networked, products from Sun have often bridged the gap between telephony-specific applications and standards-based IP networks. Sun has a long history of supporting open standards, with products that help to protect customer investments, and which ease the way to building mobile-music solutions that incorporate best-of-breed products from Sun's partners as well.

Sun Java™ System Content Delivery Server can form the foundation for wireless carriers' mobile music infrastructure. The product supports the entire content lifecycle including acquisition, storage, catalog management, and interfaces to standards-based DRM mechanisms. It supports content promotion and pricing, giving wireless carriers the tools they need to build their own branded music stores, specialty stores, and promotions including features like listening for a free trial period, or sending music to a friend. Even better, Sun's content delivery server supports J2ME platform-based applications that can offer compelling, handset-specific features that make it easy to find, preview, and purchase music through the content delivery server. Sun Java System Content Delivery Server is designed as a flexible, modular system that can be deployed as a unit on a single, highly-scalable server, or with separate modules running on individual servers or, for the utmost availability, clusters. Of course content-delivery mechanisms need vast amounts of storage to support large music catalogs, and Sun's StorEdge™ storage systems offer massive scalability, extreme availability, and exceptional performance, allowing customers to scale up to 330 terabytes of data. User directories and access rights can be handled by Sun Java™ System Access Manager, and stored onto standard Lightweight Directory Access Protocol (LDAP) servers like Sun Java™ System Directory Server, Built to integrate with existing telephone company infrastructure, billing records can be injected into Billing Support Systems (BSS) either synchronously or asynchronously through Call Detail Records (CDRs).

This white paper discusses the factors that are converging to make mobile music a whole new market for wireless carriers. It describes the needs of wireless carriers as they move into the mobile music market, and it describes a mobile music solution that can be built to support the needs of a rapidly-expanding market.

Chapter 2
Converging Factors

Wireless carriers see mobile music as a major new market that will help them increase the profits they garner from their newly-deployed, high-speed 3G networks. Wireless carriers have already seen the popularity of call-back tones in South Korea, real tones in Japan, and full music downloads in Europe. Indeed, Ovum Group ("Sound strategies: music on mobile phones," May 2004) estimated that mobile music would bring in $1.6 billion in Europe in 2004.

Why mobile music, and why now? The market is ripe because of a convergence of factors — an increasing acceptance among subscribers that mobile phones are really Internet devices; the worldwide deployment of high-speed cellular wireless IP networks, an acceptance on the part of the music industry that today's digital-rights management techniques are sufficient to protect their copyrights, and the increasing number of mobile phones supporting the J2ME platform.

Mobile Phones are Network-Enabled Computers

Subscribers are realizing that their mobile phones are really network-enabled computers that give them access to a wide range of network services, many of which are available without ever leaving the carrier's own network. With the availability of network services, subscribers are becoming increasingly interested in using their mobile handsets as multi-function devices, a trend that is propelled by the availability of high-speed networking in an increasing number of geographical regions.

The trend began with wireless messaging, deployed using technologies ranging from Short Message Service (SMS) to Multi-Media Messaging (MMS). In Europe, text messaging through SMS is widespread, and is often used in preference to placing calls. In developing countries like China, a wireless subscriber's first exposure to text messages is often through the use of a telephone handset rather than through a networked PC.

Today it's common for handsets to include large color displays, Wireless Application Protocol (WAP) browsers, and Java platform support. As various consumer devices — including Personal Digital Assistants (PDAs), cameras, and music players — have become popular, they have been incorporated into mobile handsets:

- Personal Digital Assistants (PDAs) have been integrated with cellular telephony to create products like palmOne's Treo handset, and Research in Motion's Blackberry device.
- Cameras are often integrated into handsets, a feature becoming so popular that manufacturers are competing to deliver the highest resolution cameras with digital camera-quality optics. In October 2004, Samsung announced the first 5-megapixel mobile phone, with resolution exceeding most digital cameras.
- As the Apple iPod has become the *de facto* portable music device, a race has begun to incorporate music players into handsets as well. Motorola has announced a partnership with Apple to bundle its iTunes software with Motorola phones. Meanwhile, Samsung's PH-V5400 handset is the first to incorporate a built-in hard drive for

playing full-length digital songs through its own speaker system or transmitted by FM radio — and it includes a camera as well. Other handsets with MP3 support include the Nokia 6230, Motorola E398, Siemens Xda II, and the Sony Ericsson K700i. Mobile music-enabled handsets take many forms. Some phones are equipped for music downloading over the wireless carrier's network, and these are likely to be supported and endorsed by wireless carriers. Others are equipped to synchronize with desktop PCs, and may miss a large portion of the market, namely those subscribers that use their mobile phone as their primary Internet-access device.

Of course the fact that mobile handsets can even include such features is tied to the constant improvement in semiconductor and storage technology; low-cost Flash memory that can store significant amounts of digital music at low cost, and micro-disk drives that can currently store more than 10 GB of data in a Flash memory card format.

Technology Adoption by Young Adults

Wireless carriers need to look no further than young people in any culture in order to identify the factors that will shape their business in a short few years. Internet usage is on the decline among 18-24 year-olds in the U.S., an indication that multi-function mobile handsets are becoming the preferred gateway for communication with their peers. Until recently, the top two items on a teenager's wish list was likely a mobile phone followed by a car. Today, an Apple iPod often takes the first place on that list. But as mobile music services become widespread, the top item on that list may be replaced by a mobile music-enabled phone (Figure 1). Indeed, when teens discover that they can download the latest hits anywhere, any time using their mobile music-enabled handsets, the top item on their wish lists will be a mobile-music phone.

Figure 1. Mobile phones are a necessity to today's teens, and their position on a teenager's wish list may be supplanted by stand-alone music players for only a short time.

Technology Adoption Around the World

Depending on the locale, mobile music can have an inherent edge over typical portable music players. In some South American countries where many use Internet cafés for Internet access, it is virtually impossible to download music to a PC and transfer it to a traditional portable music player. Downloading music to a music-enabled mobile phone is a far simpler proposition. In Europe, where Internet access via mobile phone is common, subscribers may prefer to access their music choices by phone rather than through PCs with high-speed Internet connections.

Some highly-developed countries like Japan have more developed wireless than wireline infrastructure, encouraging the use of wireless devices for high-bandwidth music downloads. In developing countries like China, many use mobile phones as their only gateway to the Internet, again giving mobile music an instant edge.

Music Industry Evolution

After years of losses from file sharing, the music industry seems to be accepting the reality of music downloading. In a move that signals a willingness to accept the limitations of today's digital-rights technologies, music companies have begun to make their wares available to a variety of music stores including those run by Apple and Real Networks. With relatively minor restrictions on playback and sharing imposed by today's DRM technology, customers are increasingly accepting them as only a minor inconvenience and are flocking to online music stores today.

For wireless carriers, an important distinction is developing. They can make arrangements to re-sell content from the major music publishers, negotiating separately with each one, or they can work with a new class of re-seller, the content aggregators. These providers can give wireless carriers instant access to large catalogs of digital music without the long lead time needed to negotiate with multiple publishers. While aggregators may seem like a way to reduce time-to-market, they can also have a significant impact on the margins that wireless carriers are able to make on selling music downloads.

The Ubiquitous Java Platform

Wireless carriers know that they need compelling applications in order to sell music downloads. User interfaces must be easy to use and customized to each music-enabled phone's specific screen and input attributes. They must take customers to the music they want to buy in a few short keystrokes, and make it easy to preview and download their selections. And they must be flexible enough to take subscribers to featured artists, and highlight various promotions.

Tying a music store application to handsets is not a long-term solution because it limits the carrier's market to only those specially-equipped phones, not the wide range of music-enabled phones coming to market. Web-based interfaces rendered on WAP browsers are problematic because they need to work to the least-common denominator, making it difficult to include compelling features like music previews.

Sun's Greg Wolff believes that the convergence of Java technology with network-enabled phones makes the time right for mobile music. With the massive deployment of the Java 2 Platform, Micro Edition on a large number of network-enabled handsets, the process of creating a compelling music store application and having it interact through standard protocols to back-end content-delivery services is now possible. Indeed, Ovum's Mobile Device Forecast (September 2004) projected an installed base of 579 million Java platform-enabled phones by the end of 2004. With the majority of new handsets supporting the J2ME platform, wireless carriers can be confident that their investment in the Java platform today will be one that will carry them into the future of mobile music.

Chapter 3
Mobile Music Technology

Wireless carriers must have a range of technologies all working together in order to provide a compelling mobile-music service that increases customer loyalty, reduces churn, and increases Average Revenue Per User (ARPU). This chapter outlines the technologies and features that can help wireless carriers be successful in the mobile-music market. The following chapter describes an example mobile-music architecture and the products from Sun that can help them deliver mobile-music services.

Compelling Presentation and Storefronting

Without a doubt, the most important technology that wireless carriers need in order to make their mobile-music offering successful is an easy-to-use, compelling music store application. Applications built to run on the J2ME platform can help make mobile-music services easy to find in handset menus, and as easy to use as their voice services. When built to the Mobile Information Device Profile (MIDP) specification, music-store applications can adapt to each handset's input keys and screen characteristics, making it easy for carriers to create one application that works across whatever music-enabled devices they choose to support.

Mobile-music applications should give subscribers easy access to the music they want, with simple, predictable access to content. Music buyers want more than a list of artists and songs. They want photographs of their favorite artists, album covers, links to the latest news, and even access to concert schedules and tickets. Delivering this level of rich content draws customers more deeply into the experience, increasing loyalty, creating a viral marketing 'buzz' among peers. It also requires careful staging of data on the handset, anticipating and pre-caching image data, and preparing preview clips for instant playback.

Everyone knows that music tastes vary widely, and the same graphics that attract a Britney Spears fan might alienate a customer looking for a Beethoven sonata. Wireless carriers eager to appeal to a wide range of customers need the flexibility to support multiple storefronts, each with their own look and feel that's tailored for their specific audience. The capability to create and present different storefonts and different branding can also be used to feature different artists with their own virtual stores, having a look-and–feel and additional content that is appropriate for a niche — but lucrative — market.

Carrier-Grade Content-Delivery Services

Backing up the storefront, carriers need to have highly-available, scalable, and flexible content-delivery services. They need software that can catalog and store a variety of content from numerous sources. They need to be able to obtain music from major labels and independent aggregators, storing different versions according to the handsets

they support and according to the various digital rights embedded into them. In order for carriers to make the most out of their investment, good content-delivery systems should not only handle their music-delivery requirements; they should also support all downloadable content including applications, games, ringtones, wallpaper, animations, photos, and video clips.

Content-delivery systems allow carriers to support different markets with flexible pricing models, support for different currencies, languages, and market-specific presentation. They interact with digital-rights management systems to authorize sale of content, and they interface with existing billing systems so that digital content can be charged directly to a subscriber's bill.

Flexible Digital Rights Management

A carrier's ability to execute creative marketing plans depends on the security and flexibility of their digital-rights management software. It must be secure enough to gain the confidence of the content owners that allow their music to be sold through the carrier's store. Yet it must be flexible enough to support pricing plans approved by the copyright holders that can give the carriers a marketing edge over their competition.

Consider, for example, a "send to a friend" promotion that allows subscribers to send a song to another subscriber for a single play. With groups of friends feeling that they can share their favorite tunes, they are more likely to purchase songs that they've listened to and liked.

DRM software, when integrated with content-delivery systems, should allow pricing models for protected content including free, per-download, preview-only, and a variety of usage models. These models should include playback a limited number of times, for a certain amount of time following the download, and for unlimited use between two dates.

Identity Management

Many wireless carriers have created pricing models that depend on the identity of a subscriber and their relationship to other subscribers. There are family plans that allow unlimited calls between family members; corporate plans that roll up all company subscribers into a single bill; and calling plans that discount calls between pre-specified numbers.

Wireless carriers offering mobile-music services need to offer their subscribers ways to monitor and limit the use of their services. Parents, for example, must be able to set limits on the type and amount of content that their children can download. Parental controls — or controls within any subscriber group — can make allies out of those paying the bills, whereas one large bill from an out-of-control teenager could send a good subscriber to the competition.

The most comprehensive solution for wireless carriers is to implement a central identity-management system that can be leveraged by the various business units that it supports. A centralized identity-management system can support single sign-on between services offered to wireless handsets, instantly identifying the responsible party given a mobile number, and applying any pre-determined limitations to content downloads before the sale. Centralized identity management can help support various calling plans, and can support other business units including public-access WiFi networks that many carriers are deploying.

Open Standards-Based Infrastructure

One of the most strategic choices that a wireless carrier can make is the choice to deploy systems that are built to support open standards. Ever since its very first workstation integrated standards-based TCP/IP networking with the UNIX® operating system, Sun has helped to promote open standards and then has competed in the marketplace to deliver the best implementation. Open standards foster competition that can result in lower prices to cus-

tomers, and higher product quality. Most important for wireless carriers is that when they deploy mobile-music solutions using open standards, the result is a modular architecture where components from Sun — and its competitors — can be interchanged to create true, best-of-breed solutions. Some of areas in which wireless carriers can leverage open standards in their mobile music operations includes:

- *Music Encoding Standards*. Supporting handsets and content that uses standard encoding techniques like MP3 and AAC can help to minimize the complexity and volume of content carriers must store.
- Java Platform. Using the Java 2 Platform, Micro Edition platform and the MIDP specification allows carriers to reach a wide variety of music-enabled phones, with presentation and input techniques mapped automatically by the platform. This helps carriers to reach the widest possible customer base while minimizing their investment in handset-dependent software.
- *Open Mobile Alliance (OMA) Digital Rights Management*. When carriers use DRM systems that conform to OMA standards, they increase their ability to implement modular, best-of-breed solutions rather than those that are specific to a particular vendor or music aggregator. Sun helps to promote open standards-based DRM through its membership and participation in the Open Mobile Alliance.
- *Billing System Integration*. Wireless carriers expand their markets, offer new and innovative services, but one element of their infrastructure that typically remains the same is their billing system. Deploying mobile-music systems that integrate with billing systems through standard Call Detail Records (CDRs) is one way to avoid billing and integration headaches. Another way to help minimize the cost and risk of integrating new services into existing OSS/BSS systems is through Application Programming Interfaces (APIs) supported by the OSS Through Java™ Initiative. OSS/J is an industry-collaborative effort to develop, test, and publish a suite of APIs for OSS in the telecommunications industry. By using common APIs for OSS, wireless carriers can significantly reduce integration costs while simplifying the process of bringing new services online.

Scalability, Availability, Manageability, and Security

When deploying mobile music solutions, wireless operators must pay attention to the same issues that they must consider for any carrier-grade service: scalability, availability, manageability, and security. First and foremost, their systems must scale to support initially hundreds of thousands of titles, but ultimately millions of them. They must be able to scale their storage systems to handle the large volumes of music, and they must also be able to scale their content-delivery services to support a rapidly-increasing number of subscribers.

Carriers need to be able to scale their services in two dimensions. Horizontal scaling uses additional servers to support a service, increasing availability by eliminating single points-of-failure. Vertical scaling uses additional resources — like CPUs, memory, and network resources — to increase the capacity of each server. Sun supports both dimensions of scalability in its 1-4 processor x86-architecture servers that can run the rock-solid Solaris™ Operating System or Linux, depending on the carrier's choice. For scalability from 1-106 processors, Sun's UltraSPARC® processor-based product line can support the most demanding applications. Both vertical and horizontal scaling are needed to build the most flexible mobile music solutions, and Sun's long history building Internet architectures for the telephone industry can be a key asset to wireless carriers.

Sun servers are manageable, from the lights-out management systems on many servers that allow wireless carriers to access the most basic server functions remotely to dynamic reconfiguration that can allow components to be added or replaced without bringing a system down. The Solaris 10 Operating System brings a new level of manageability to help further increase reliability, including predictive self-healing features that can diagnose and in some cases, repair faults before they cause system failures. Fine-grained resource management features in the Solaris Operating System facilitate server consolidation, allowing wireless carriers to support a smaller number of high-capacity servers and deploy multiple applications on each one.

Resource management facilities go hand-in-hand with new security features in the Solaris 10 Operating System, including Solaris™ Containers, which provide a secure, virtualized operating-system environment. Combined with resource controls, Solaris Containers allow multiple applications to coexist on the same server that would otherwise overlap in their need for resources (like configuration files or network ports). These features, plus process and user-rights management, a new built-in firewall, and the new Solaris Cryptographic Framework makes the Solaris Operating System one of the most secure systems available anywhere.

Chapter 4

Open Standards-Based Mobile Music Architecture

Sun's vision for a mobile music architecture is based on the Sun Java System Content Delivery Server, end-to-end Java software supporting mobile-music storefronts, and open standards-based interfaces between components — resulting in a modular, flexible, scalable architecture. This chapter gives an overview of Sun's mobile music architecture with a detailed discussion of its key components and interfaces.

An Open Standards-Based Architecture

Using several key components from Sun Java™ Enterprise System, along with open standards-based third-party products like DRM systems, wireless carriers can construct their own mobile-music sales and distribution systems, giving them control over the entire content lifecycle, from acquisition to download. It also gives them control of their own marketing and pricing structures, allowing them to innovate independently from competitors that use pre-packaged mobile music products or services. When carriers deploy efficient mobile music architectures, they take control over their own cost model, giving them greater leeway in how they price their end products. An example architecture is illustrated in Figure 2. Its key components and interfaces are outlined below and are described in detail in the sections that follow:

- *Sun Java System Content Delivery Server*. This product forms the core of the solution, handling the content lifecycle including acquisition, cataloging, storage, applying DRM protection, and download. It handles aspects of music store operations, including content promotion, pricing, branding, specialty stores. It handles subscribers and the devices they use, delivering content that is appropriate for their devices. Finally, it handles authorization and billing functions.
- *End-to-End J2ME Platform-Based Solution*. Compelling mobile music storefronts can be built to run on the J2ME platform, giving wireless carriers access to an extraordinary range of mobile devices. Unlike mobile WAP browsers, where each user selection can result in delays as the next screen is fetched, a mobile-music store application can be built with intelligence. It can predictively cache content to speed the response to user selections, or to quickly begin playback of a preview clip. Such an application would have two components: one that resides on the handset, and one that runs on the carrier's servers. On the carrier side of the connection, a software module interfaces with the content delivery server and supports the mobile-music application. The mobile handset application can connect securely to the back-end software using Secure Socket Layer (SSL) over HTTP, or HTTP/S. Once content is sold through the store, Sun Java System Content Delivery Server can deliver purchased content using whatever mechanism the carrier deems most efficient, including Short Message Service (SMS) and Multimedia Messaging Service (MMS).

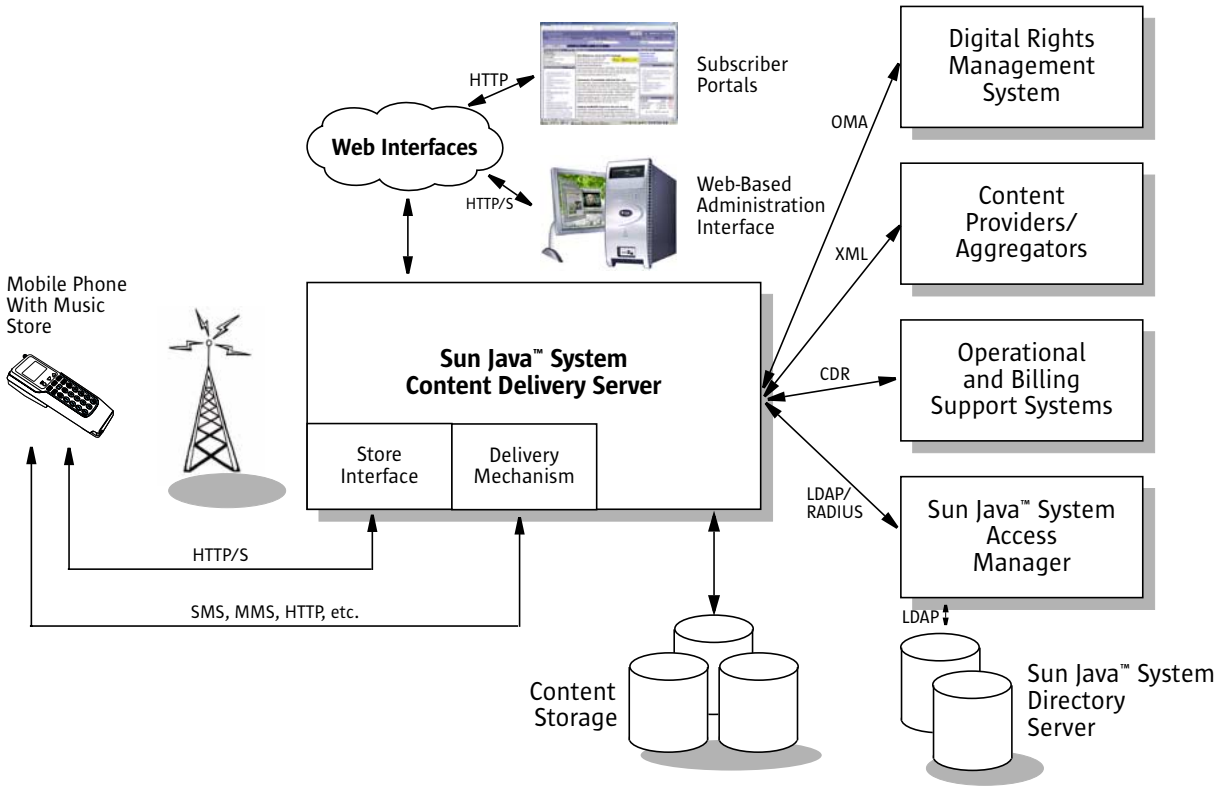


Figure 2. An example mobile music architecture for a wireless carrier is based on Sun Java System Content Delivery Server and open standards-based interfaces from the subscribers mobile device to back-end DRM and identity management systems.

- *Web Interfaces and Portals*. Sun Java System Content Delivery Server provides a Web-based administration interface for both system configuration and content management. Wireless carriers can also provide Web-based portals so that subscribers can order music through wired Internet connections from their home PCs
- *Digital Rights Management System*. Sun Java System Content Delivery Server communicates with third-party DRM systems through Open Mobile Alliance (OMA) standard interfaces. External DRM systems support the entire process including content protection, rights management, license generation, and license delivery to handsets.
- *Content Providers and Aggregators*. For trusted content providers and aggregators, carriers can configure Sun Java System Content Delivery Server to accept content in batches using the aggregator APIs. Alternatively, administrators can obtain and submit content manually. Regardless of the submission method, wireless carriers must accept the content and approve suggested pricing for it.
- *Operational and Billing Support Systems*. Sun Java Content Delivery Server interfaces through standard carrier OSS/BSS systems to initiate billing for downloaded content. It can synchronously request approval from the carrier's OSS/BSS systems, not allowing the download to take place unless approval is received. Alternatively, it can produce call detail records asynchronously.
- *Sun Java System Access Manager*. Sun Java System Access Manager can handle identity management for subscribers, allowing carriers to implement innovative features like family plans, and allowing subscribers the power to control their own download rights allowing, for example, parents to manage their childrens' music downloading capabilities. Sun Java System Access Manager uses the high-capacity, high-speed data store provided by Sun Java System Directory Server.

Sun Java System Content Delivery Server

Sun Java System Content Delivery Server is the core of a wireless carrier's mobile music infrastructure, allowing operators to launch, promote, and sustain profitable content services. The product can efficiently manage the complete content lifecycle, streamlining content submission, testing, verification, management, matching types of content to appropriate devices, notifying subscribers of new content, handling content delivery, and tracking information for reporting and billing purposes. Sun Java System Content Delivery Server is not limited to storing music content for mobile-music services; carriers can leverage it to support all of their downloadable content including games, ringtones, animations, photos, and video.

Flexible, Component-Based Architecture

One of the unique attributes of Sun Java System Content Delivery Server is its flexible, component-based architecture. A modular architecture facilitates integration into existing network infrastructure by connecting with the carrier's existing gateway systems including Multimedia Messaging Service Centers (MMSCs), Short Message Service Centers (SMSCs), WAP gateways, Push-Proxy gateways, and messaging systems for Instant Messaging (IM) and e-mail. Sun Java System Content Delivery Server also integrates with a carrier's billing, subscriber directory, and Customer Relationship Management (CRM) systems.

Sun Java System Content Delivery Server is divided into separate subsystems, each of which can be hosted as necessary depending on the number of subscribers, scalability, and availability requirements. The product's design allows carriers to use clustering strategies when deploying the product, delivering the high availability and scalability that carrier-grade networks demand.

Core Components

Sun Java System Content Delivery Server consists of a catalog manager, vending manager, and fulfillment manager (Figure 3). Providers submit their content through the Developer Portal. Once received, it is reviewed, approved, and placed in the centralized Catalog Manager before being made available to subscribers. This gives wireless carriers complete control over the content they accept from music publishers and aggregators.

From the Catalog Manager, approved content is stocked into Vending Managers. At the operator's discretion, all content can be published to one or more Vending Managers, or individual Vending Managers can be stocked with selected content only. Customizing Vending Managers allows an operator to centrally manage all content while branding different Vending Managers for different target audiences. For example, separate vending managers can be set up for different classes of music or for featured artist stores, each having their own look and feel.

Catalog Manager

The Catalog Manager allows a wireless carrier to centrally manage a warehouse of content that can be selectively distributed to various Vending Managers that support specialized stores or operations in different locations. The Catalog Manager provides an interface for content providers to submit their products to the carrier. Once submitted to the Developer Portal, the Catalog Manager verifies and certifies content according to rules defined in a configurable workflow, enforcing developer submission policies. The administrator has complete control over what content is accepted, how it is categorized, priced, and distributed. The Catalog Manager also manages handsets, matching content with device capabilities so that only content appropriate for a specific handset is shown. It will not, for example, sell AAC-encoded music to a device that only plays MP3-encoded content.

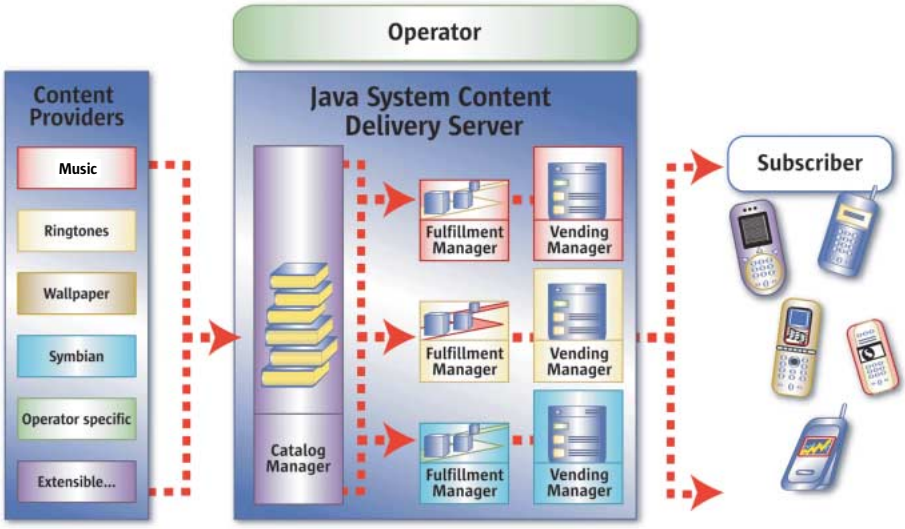


Figure 3. Overview of Sun Java System Content Delivery Server illustrating its Catalog Manager, Fulfillment Manager, and Vending Manager.

Vending Manager

The Vending Manager supports content sales through multiple channels, each of which can have its own pricing model. A Vending Manager administrator selects content from the Catalog Manager for retail stocking, discovery, and purchase. Each vending manager can be configured for each market segment, addressing differences in language, currency, and market-specific pricing, and presentation. Multiple Vending Managers selling from a single Catalog Manager allows carriers to present the same content for different market segments, for example creating different stores for different markets, or creating feature stores with music from a single or a set of artists. The Vending Manager can present content for sale through a subscriber portal or on the wireless device itself.

The ability to create multiple Vending Managers means that wireless carriers can use the same infrastructure for all of their stores, allowing them to rapidly respond to artist popularity with featured stores, and do business in multiple countries. This helps carriers lower costs, speed integration with existing infrastructure, and minimize time to market.

Fulfillment Manager

The Fulfillment Manager is responsible for content delivery, DRM, and billing. It offers a high-performance delivery mechanism that incorporates support for fast downloads, multiple pricing models, flexible push/pull delivery channels, real-time download monitoring, and edge caching of popular content.

Subscribers can register, edit their own profile, change passwords, and access content from a PC or the mobile device. New subscribers are provisioned automatically the first time they connect to the service, making access a simple, straightforward process.

Content Management

Wireless carriers can manage their relationships with content providers and developers, accepting new content for approval and processing. Content providers can submit new content, updates to existing content, and offer additional editions of existing content that targets new devices or device capabilities. Carriers can assign content providers to different tiers, accommodating different plans or programs, such as standard, gold, and platinum levels

of service. Pre-assigning content providers to categories can speed new content to music stores, for example, by pre-categorizing the genre of music that they are submitting to the content management server.

Content Promotion and Pricing

One of the most important considerations for wireless carriers is how well their mobile-music infrastructure supports the ability to launch innovative marketing programs that increase ARPU and attract customers from competing carriers. Sun Java System Content Delivery Server enables carriers to define campaigns, create advertisements, select promotions, define subscriber segments, and set schedules for promoting new and existing content. Advanced promotional tools supporting sponsored content, coupons, gifting, and content bundling gives carriers the tools they need to launch more effective campaigns, driving mobile music use and adoption.

Sun Java System Content Delivery Server can manage a variety of complex pricing arrangements that are appropriate for digital content. This complements wireless carriers' billing systems by managing the complexities of different promotional plans, passing charges on to billing and/or credit-card clearing system when transactions are complete. With this technology, carriers can offer all of the songs in an album for a single low price. They can create bundles of different content types, for example both a new hit song, a corresponding ringtone, and a similar song from an independent distributor. They can implement "buy two, get one free" promotions, subscriptions, and plans that allow specific numbers of downloads in a specified time (such as a month).

Send to a Friend

One lesson the industry has learned from the file-sharing frenzy is that users are more likely to try music from someone they know. Sun Java System Content Delivery Server provides capabilities for creating viral, customer-to-customer marking programs. Features including "send to a friend" and music coupons enable subscribers to tell each other about their favorite music. Wireless carriers can leverage their core users to promote new content and to cost-effectively reach out to subscribers with special offers that might otherwise be missed in the store or Web portal. This content can be marketed through opt-in programs and sent to customers targeted by their purchase history via push notification including SMS, SMS+, MMS, e-mail, or WAP.

Coupons, Gifting, and Sponsored Promotions

Coupons can be essential tools in mobile music marketing campaigns. Coupons can be sent to subscribers, who can then forward them to other users — even customers of other wireless carriers (Figure 4). Non-subscribers can download content represented by the coupon after the Vending Manager matches the type of music encoding to the capabilities of the user's handset. The ability for customers to market to their friends outside of the carrier's subscriber base can be one of the most effective marketing techniques available.

Subscribers can also purchase a coupon as a gift to another subscriber. Once the recipient successfully downloads the song, the Coupon Manager determines how to bill the sender.

Third-Party Promotions

Wireless carriers can form alliances with business partners that allow them to promote the carrier's content. These can take the form of affinity programs, for example where the customer buys a certain number of fast-food meals and receives a coupon for a free song. These promotions can be billed to the third party, or the costs absorbed by the carrier. For these promotions, a coupon is created by the vending administrator, specifying the sponsored pricing. A coupon code is specified for the promotion, which is provided to the business partner. After receiving the coupon, the subscriber enters the code when purchasing content. The Coupon Manager accepts the coupon code and determines the cost to the partner.

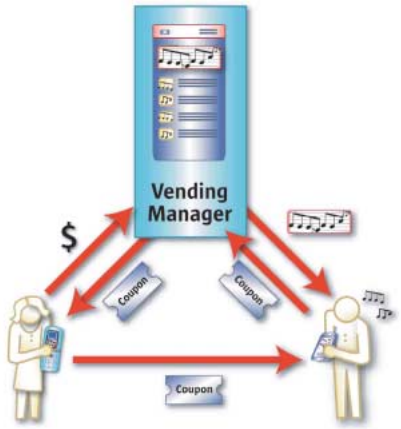


Figure 4. Subscribers can buy coupons for music and send them to friends. They are redeemable regardless of whether or not the friend is a subscriber.

Pricing

Wireless carriers can make their mobile-music services more attractive to subscribers and content providers by supporting multiple pricing models. Flexible pricing rules support a variety of business models for different subscriber groups. Pricing options include free, pay once, pay per download, pay per use, pay per time period, subscriptions, and trials. Pricing for music content is intimately tied to the third-party DRM software integrated with the system, an issue discussed in "Digital Rights Management" on page 19.

Subscriber Interfaces

Sun Java System Content Delivery Server is designed to make it easy for subscribers to discover and download content, enhancing their experience and helping to increase business. Subscribers can access the music store through the Subscriber Portal from both their mobile devices and their PCs. Carriers can manage subscriber plans to provide the most appropriate content depending on their characteristics.

Subscriber Portal

The Subscriber Portal allows subscribers to edit their profiles, change passwords, and opt in and out of promotional campaigns. They can access the music store through their personalized storefront from either their mobile device or their PC. New subscribers are provisioned automatically the first time they connect to the service, making access a simple, straightforward process.

For carriers with existing subscriber portals, Sun Java System Content Delivery Server provides Java software and XML-RPC APIs to ease integration with existing systems. For carriers interested in providing compelling music store applications built on the J2ME platform, Java software APIs can be leveraged to create a server-side module that supports subscriber handset-based software.

Compelling Music Stores with Java Technology

Mobile phone users aren't necessarily computer users. They are used to the quick responsiveness of voice and want the same immediate response when searching for and buying mobile music. Unfortunately, the interfaces on many mobile devices make it difficult to locate and navigate through Web-based stores without a large number of clicks, each one involving a delay as the phone's WAP browser downloads the requested page. The ensuing lack of responsiveness turns customers away, resulting in a significant number of sales not closed.

Mobile Music Store Application

The solution to these usability issues is for wireless carriers to deploy programmatic interfaces to their music stores, providing a consistent, customized, well-branded, multi-media presentation to the user that minimizes the number of clicks to discover and purchase content. Using a mobile-music store application — rather than WAP interface — can make the user experience better in a number of ways:

- Rather than having to find data services deeply nested in their mobile device interfaces, customers can use a single music-store application to locate, preview, and purchase their content.
- The music-store experience can be made fun, unified, and intuitive, and it can support all types of content that the wireless carrier sells through Sun Java System Content Delivery Server.
- The store can provide a multimedia experience, with album covers, previews, and choices customized to the user's preferences.
- Customers can filter automatically for specific types of music, rather than being presented with a full list of alphabetized choices.
- Music previews can be played through the application interface, making it easier to make music selections.
- The mobile-music store can display promotions at start-up, allowing the subscriber to scroll through multiple promotions or go directly to the music-store departments that interest them the most.
- The store can include locations for favorites, wish-list items, and recent purchases.
- Rather than being delayed at each click for the next page to download, a programmatic interface can intelligently cache graphics, text, and content so that customers experience a snappy response time.

Benefits to Carriers and Content Providers

By providing users with a Java technology application to access their mobile-music stores, wireless carriers not only improve the user experience, they also help them to realize quantitative business benefits. A fun and intuitive interface can help to increase the amount of content sold while reducing the abandon rate and increasing customer satisfaction Content sales increase utilization on the carrier's data services network, helping to offset the costs incurred in purchasing the bandwidth and deploying the wireless network. When mobile-music stores are used to sell other digital content including ringtones, images, videos, animations, and games, carriers can increase cross sales through bundles and recommendations ("if you like this song, you'll love the ringtone.")

Content providers can also benefit from easy-to-use mobile-music stores. They can be assured of a sophisticated distribution channel that puts their products in the best light. Photos and graphics included in product description pages can help extend their brand and increase their product sales at minimal cost. They can work with wireless operators to form intelligent webs of related music so that application-generated recommendations can more accurately target customer preferences and result in higher sales.

J2ME Platform-Based Mobile-Music Store

The choice of the Java 2 Platform, Mobile Edition platform simplifies the task of producing an effective mobile-music store application for wireless devices. The J2ME platform is included on a large number of mobile devices today, making it the *de facto* standard when wireless carriers want to write one application that can run on many devices. With handsets varying so much in display size, display color depth, processing power, memory capacity, navigation models, and APIs, it was once difficult to produce an application that would run well on a large number of handsets. Today, Java applications leveraging the MIDP run-time environment can help music-store applications automatically adapt to the specific handset in use, virtually eliminating the costly and time-consuming process of localizing software to each possible device. On the service-delivery side of the carrier's infrastructure, wireless carriers can integrate with public interfaces provided by Sun Java System Content Delivery Server and run on industry-standard application server products like Sun Java™ System Application Server.

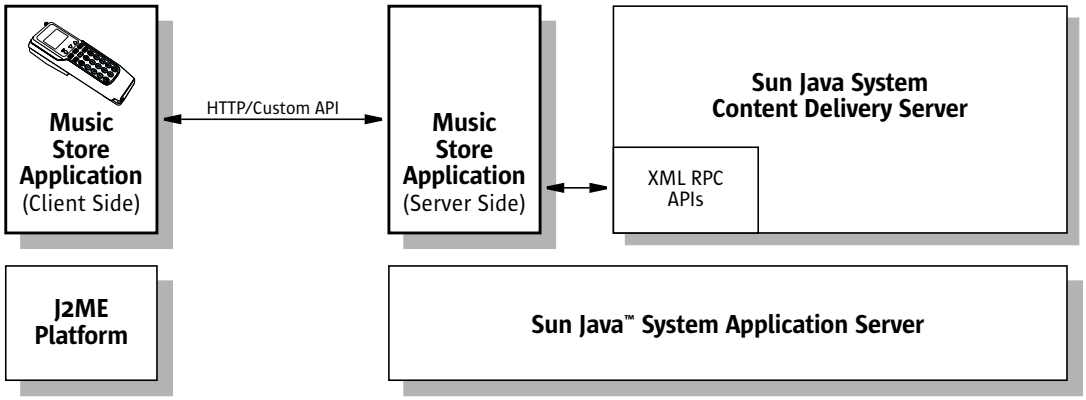


Figure 5. An example Java technology-based mobile-music application uses the J2ME platform on the client side, and the J2EE platform on the server side. Server-side software integrates with Sun Java System Content Delivery Server.

Client-Server Application

Wireless carriers can implement a client-server mobile-music application following the model illustrated in Figure 5. The client side runs on the handset, and is written to the J2ME specification, utilizing the MIDP run-time environment that helps the software adapt to the handset specifications automatically. Using the J2ME platform allows carriers to build modular, object-oriented software that makes it easy to customize look-and-feel and branding elements should the carrier decide to support multiple stores. Business processes, such as the checkout process, can be built into the client software, minimizing transactions with the server, and helping to improve application responsiveness and customer satisfaction.

Server-side software is written to the Java™ 2 Platform, Enterprise Edition (J2EE™) specification so that it can run on standard application servers with distributed object handling built in. The server side of the music-store application can share a data model with the client side. With a carefully-designed data model, the application as a whole can intelligently manage what application data (such as graphics and music previews) is cached in the handset, with data stored on the server side ready to download with minimal latency. One communication model that is both easy to implement and can be leveraged to support large numbers of customers is an HTTP connection between client and server, with message formats specific to the application. While it can use HTTP as its connection protocol, the server side can support *disconnected operation*, where the client can disappear when the phone is turned off, or where the subscriber enters an area with no coverage.

Integration with Sun Java System Content Delivery Server

Sun Java System Content Delivery Server is built to be extended, so the server-side music store application can integrate to the content delivery server using standard XML-RPC APIs. Interacting directly with the content delivery server, the server-side music store application can obtain the data it needs in order to support a shared data model clients on subscriber handsets.

Content Providers and Aggregators

Once the mobile-music market begins to take off, wireless operators will find themselves competing to offer the most comprehensive music catalogs to their subscribers. This requires carriers to obtain access to the huge amount of digital music already available, quickly obtain new releases of popular artists as they come onto the

market, and integrate the wares of small music aggregators that can round out a music catalog with local and niche artists.

Sun Java System Content Delivery Server streamlines the process of working with third-party content providers. The server's Content Aggregator interface provides an XML-RPC interface by which publishers and aggregators can load content into a carrier's catalog (Figure 6). The interface also allows the content-delivery server to integrate with externally-hosted content linked to by a Uniform Resource Locator (URL). Using the Content Aggregator interface, wireless carriers can quickly and easily integrate large batches of music into a single catalog from external content aggregators. Sun Java System Content Delivery Server provides secure and reliable delivery of all content, whether stored in the carrier's database or hosted externally at a third-party publisher or content aggregator.

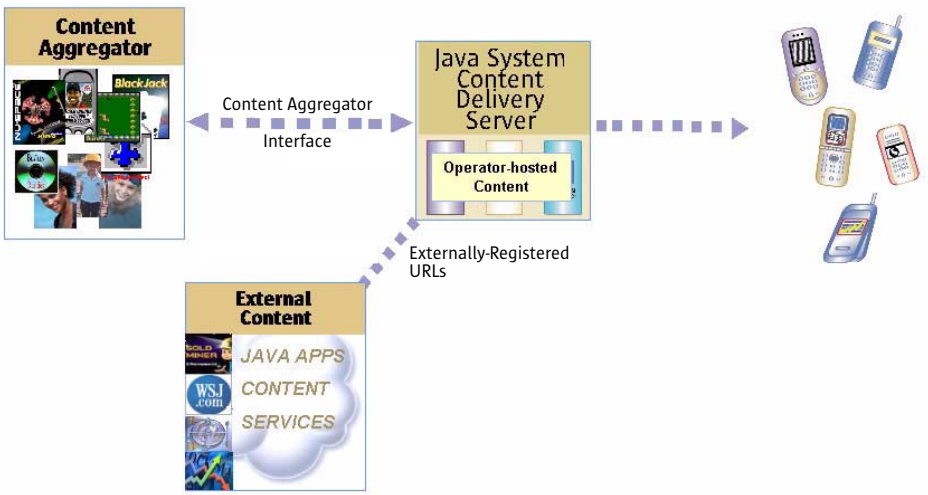


Figure 6. Wireless carriers can use the Content Aggregator interface to move batches of music into Sun Java System Content Delivery Server, and it can also access content stored outside of the server via URL.

Once incorporated into Sun Java System Content Delivery Server, content must be stocked into Vending Managers. For trusted content providers, the stocking process can be accomplished automatically, with standard mark-up percentages applied. For other vendors, the Vending Manager administrator reviews and selects which content to stock, setting a retail price, trial usage terms, and how to categorize the tune. Once stocked, content is made available to subscribers through the retail storefront — whether a separate music-store application sells the music or whether the default capabilities of Sun Java System Content Delivery Server are used.

Digital Rights Management

Digital rights management is a key component of mobile-music store operations. Not only does DRM control usage rights and how content is delivered — it determines constraints of the innovative marketing campaigns that wireless carriers can use to sell their wares, for example those discussed in "Content Promotion and Pricing" on page 15. Sun Java System Content Delivery Server uses a standards-based DRM framework that allows wireless carriers to offer flexible billing models to subscribers, enable protected content sharing, and even allow subscribers to re-download previously-purchased content to new devices.

Open Standards-Based DRM

Sun believes that, for DRM to be successful, implementation strategies must be built on interoperability between parties in the value chain, including content providers, aggregators, DRM and content platform vendors, wireless carriers, and users themselves. At each end of the chain, content providers want to be paid for the content they provide, and users want to get what they paid for with minimal interference in how they enjoy their music. Because of the number of parties involved, Sun believes that open standards-based DRM systems have the best chance of succeeding in the marketplace. In particular, Sun Java System Content Delivery Server integrates with OMA DRM 1.0 standard-compliant DRM servers today, and is prepared to support interfaces for the OMA DRM 2.0 standard as it is developed.

DRM with Sun Java System Content Delivery Server

DRM systems accomplish their goals by modifying digital content so that it is not playable without a DRM agent — on the handset or at the carrier — approving its playback. Sun Java System Content Delivery Server can protect content either at the time of submission or on-the-fly when the content is delivered. Protecting content at the time of submission allows the content-delivery server to cache the content in its download component, allowing multiple concurrent downloads, a desirable characteristic for wireless carriers supporting millions of subscribers. With content protected at the time of submission, it's important for carriers to store different versions of each piece of content, each one protected with the different rights that the carrier might offer.

Delivery Mechanisms

Sun Java System Content Delivery Server supports three delivery systems that are part of the OMA 1.0 standard, as illustrated in Figure 7:

- *Forward Lock*. This mechanism allows content to be delivered in plain format, but the subscriber is prohibited from transferring the content to any other device.
- *Combined Delivery*. The content is delivered in plain format bundled with usage rights. The subscriber is not allowed to transfer the content to any other device.
- *Separate Delivery*. The content is delivered in encrypted format, and usage rights are delivered separately to the subscriber. Unlike with forward-lock and combined-delivery mechanisms, content encryption allows subscribers to freely transfer music to other devices and to other subscribers, but without playback rights. Once another subscriber receives the encrypted content, for example, their handset would have to obtain permission from the content delivery server to play the content. "Send-to-a-friend" promotions could be implemented, for example, by allowing the friend to play the content a single time. If the friend liked the song, they could purchase the access rights from the music store.

Pricing Models

Sun Java System Content Delivery Server supports both free and per-download pricing for content delivery with no digital-rights management. For content protected using OMA DRM 1.0 standards, the content-delivery server supports the following pricing models:

- Free
- Per-Download
- Preview Only
- Play content a specified number of times
- Play content an unlimited number of times for a specific time period following the download (Sun Java System Content Delivery Server can be configured for automatic re-subscription)
- Play content an unlimited number of times between two dates

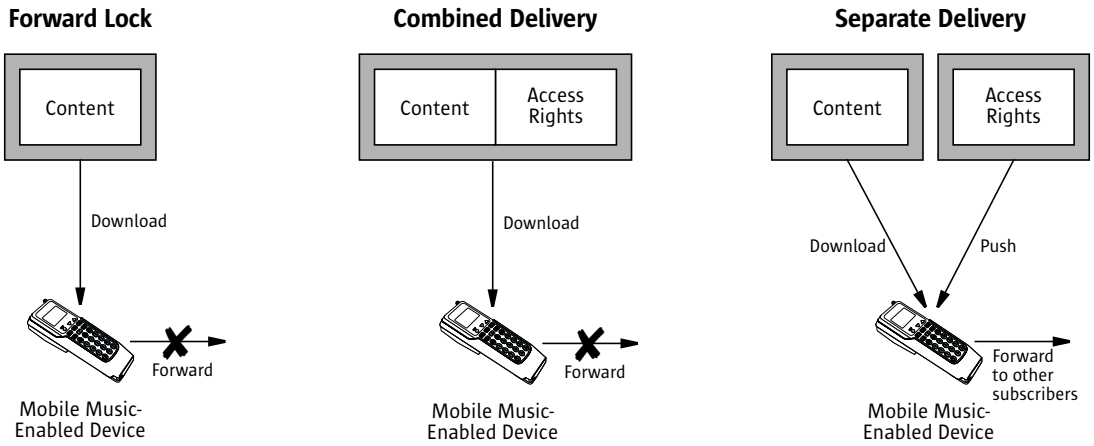


Figure 7. Sun Java System Content Delivery Server supports three content-delivery mechanisms supported by the OMA DRM 1.0 specification.

Sun Java™ System Access Manager

When wireless carriers integrate a carrier-grade identity-management framework into their mobile-music architecture, they enable more sophisticated calling plans and joint-marketing arrangements.

For example, a calling plan that combines billing for all family members on a single account almost requires having parental controls over childrens' music downloading capabilities. In addition to governing how much content, if any, a specific family member is allowed to purchase, carriers can give account owners the ability to control the categories of music downloaded. Features like this require the ability of the wireless carrier to associate multiple handsets with a single account, to associate specific permissions with each one, and to give the account holder (such as a parent) the ability to modify the permissions associated with each handset. This requires an underlying identity-management infrastructure that allows carriers to delegate authority to subscribers so that they can specify some characteristics of their account.

Identity-management frameworks can support single sign-on to multiple sites or stores within the wireless carrier's purview. They can also support single sign-on between companies participating in joint-marketing promotions. For example, consider the fast-food restaurant offering a free music download after purchasing a specific number of meals. When a customer purchases a meal, they receive a code to give to the restaurant's affinity site. The customer logs in and accumulates an additional point in their account. Once a sufficient number of points have been accumulated, the restaurant presents the customer with a coupon for a free download. Since they have already logged into the restaurant's site, they are automatically logged into the wireless carrier's music store, where they can redeem their coupon. Features like this require the ability to support federated identity across multiple organizations, a capability supported by Liberty Alliance protocols — and Sun Java System Access Manager.

Open Standards-Based Identity Management Framework

Sun Java System Access Manager provides a security foundation that allows wireless operators to manage access to applications hosted within their organizations and between multiple business partners. It provides open standards-based authentication and policy-based authorization with a single, unified framework. Features of key importance to wireless carriers include:

- *Single sign-on* that improves user experience by enabling subscribers to use their identity established by the carrier infrastructure to access multiple resources, applications, platforms, and Internet domains. Single sign-on forms the foundation on which carriers can support affiliate marketing programs.
- *Federated identity support* through Liberty Alliance Phase 2 and Security Assertion Markup Language (SAML) 1.1 specification compliance. These protocols enable authentication and authorization across federated business networks, providing increased revenue opportunities by supporting trusted partnerships — while helping to reduce costs with increased efficiency.
- *Session management* that maintains session state for subscribers that can be accessed by any of the applications for which SSO and federated identity are supported.
- *Delegated authority* can be used to set up hierarchies that, for example, can be used to allow a family subscriber to set up sub-accounts — with unique application preferences and spending limits — for each family member.
- *J2EE architecture and comprehensive APIs* are used to build an open standards-based system that helps carriers implement high levels of integration and customization. The use of the J2EE specification allows developers — such as those creating innovative business applications — to extend their existing Java technology skills, helping to reduce cost and time to market.
- *Enterprise-class scalability and reliability* helps Access Manager grow with the speed of a wireless carrier's business, while providing availability levels appropriate for telecommunication carriers. Sun Java System Access Manager can be deployed in ways that help eliminate single points of failure, for example through the use of multiple load-balanced policy servers, policy agents, and directory instances that provide high availability and failover capabilities.
- *Real-time audit* provides up-to-the-minute auditing of all authentication attempts, authorizations, and changes, delivering improved security with instant auditing of critical access-related information.

Operational and Billing Support Systems

Sun Java System Content Delivery Server integrates with a wireless carrier's existing OSS/BSS systems, and can also integrate with settlement engines to allocate revenue across all of the players in the value chain, including the artist, record company, aggregator, and distributor.

Sun Java System Content Delivery Server can communicate synchronously to perform authorization checks and accounting transactions, or in batch mode by providing billing information through call detail records. Sun Java System Content Delivery Server can also query the billing system in real time to determine pricing and billing rules for discounting purposes. Prepaid, hot billing, and prepaid billing models are supported.

- *Asynchronous, or batch mode billing* generates CDRs that the billing system processes on its own schedule. Subscribers are allowed to download or continue to use content without additional verification from the billing system.
- *Synchronous billing* queries the carrier's billing system and waits for a response before allowing the purchase transaction to proceed.

Integration with OSS/J APIs

Wireless carriers face a larger, more general challenge of how to quickly deploy new services and integrate them with their existing OSS/BSS infrastructure. The OSS Through Java Initiative is a collaborative industry effort to create a set of standard Java technology APIs for integrating new services — such as mobile music — with existing systems. Focused on the needs of communication service providers, OSS/J specifies a set of interfaces including inventory, trouble-ticket management, service activation, and billing. Carriers can implement OSS/J using freely-available Java™ Connector Architecture adaptors that link to their legacy systems and provide J2EE platform interfaces that can be used by the new services that they roll out.

Using OSS/J interfaces, carriers can use off-the-shelf, component-based integration software that help more simply transform OSS silo-architected systems into fully integrated, automated operations. OSS/J is part of Sun's end-to-end strategy for Java technology in the telecommunications industry. With the J2ME platform supporting compelling, handset-based mobile music stores, Sun Java System Content Delivery Server supporting storage, management, and delivery of services to mobile devices, and OSS/J facilitating integration into existing infrastructure, wireless carriers have a consistent, effective set of tools when they deploy new services based on products from Sun.

Chapter 5
Conclusion

Sun understands the needs of wireless carriers, and it understands how important the mobile-music market is likely to be. With hundreds of millions of mobile devices sold every year, only a fraction of them need to be music enabled in order for the wireless mobile-music market to dwarf the portion currently dominated by Apple's iPod and iTunes Music Store. Wireless carriers that understand how many of their subscribers would prefer to download music directly to their mobile device — rather than through a PC first — know how important it is to be open for business when their customers come knocking.

Sun is ready with the servers, storage, software, and client services that can help wireless carriers get up and running with mobile-music offerings. Sun's mobile-music architecture is based on Sun Java System Content Delivery Server, a product that wireless carriers use today to sell other forms of content including ringtones, animations, games, and images. Sun believes in the use of open standards, and its content-delivery server integrates with trusted third-party digital-rights management software using the OMA DRM 10 standard. It has an RPC-XML interface to allow music publishers and aggregators to deliver their content in bulk, speeding the newest hits to market. Sun's decades of experience with telephone companies and wireless carriers tells it that current operational and billing-support systems are here to stay, so Sun Java System Content Delivery Server speaks their language — call detail records — when charging customers for content. Organizations of all kinds understand the growing importance of identity management, and its ability to unify user experience across multiple applications, and to support affiliate marketing programs that can deliver more customers to the carrier's door. Sun Java System Access Manager supports these features through Liberty Alliance Phase 2 and Security Assertion Markup Language (SAML) 1.1 specification compliance. Finally, Sun brought "Write Once, Run Anywhere™" Java technology to mobile devices, allowing carriers to develop and deploy compelling, easy-to-use mobile-music store applications that adapt automatically to a wide range of handsets.

The mobile-music market is one that wireless carriers are taking seriously — and with leverage from products and experience available from Sun Microsystems, wireless carriers can implement some of the most scalable and available, carrier-grade services available anywhere.

Chapter 6

References

Sun Microsystems posts complete information on its hardware and software products and service offerings in the form of data sheets, specifications, and white papers at its Web site, *http://www.sun.com*. For more information on specific products mentioned in this paper, please refer to:

- Sun Java System Content Delivery Server, *http://www.sun.com/software/products/delivery_server.*
- Sun Java Enterprise System, including Sun Java System Access Manager, *http://www.sun.com/javaenterprisesystem*.

Chapter 7

About the Authors

Bruce Baikie

Bruce Baikie is responsible for developing Sun's global telecom strategies and strategic alliances with an emphasis on wireless services and platform infrastructure. His position leverages extensive knowledge in wireless architectures, mobile service delivery environments and next-generation wireless and broadband services. Bruce delivers field sales and marketing collateral to promote partner solutions developed by Network Equipment Manufacturers (NEPs), ISVs, IHVs, and consulting organizations. A key member of the Sun's telecom team, his responsibilities also include partner contracts and negotiations, solution architectural designs, managing iForce[SM] partner implementations and direct global field sales support. Mr. Baikie holds a B.S. in Mechanical Engineering from Michigan Technological University and a B.A. in International Business from the University of Wisconsin.

Steve Gaede

Steve Gaede is a freelance technical writer and technology consultant. In his work with PointSource Communications, he develops numerous documents each year for Sun Microsystems. His history includes work with Amdahl Corp., Bell Laboratories, Cray Laboratories, NBI, Inc., and Software Design & Analysis Inc. Steve performs technology assessments, builds proof-of-concept prototypes, conducts performance evaluation projects, and develops IT best practices through his consulting company, Lone Eagle Systems Inc. He is active in the Boulder Colorado professional community, and has been a coordinator of the Front Range UNIX Users Group since 1984. Mr. Gaede received his B.S.E. in Computer Engineering from the University of Michigan and his M.S. in Computer Science from the University of California, Berkeley.

Greg Wolff

Greg Wolff is the Group Marketing Manager for Sun's Content Delivery Business, with seven years at Sun. Previously, he was a founder of Diba, Inc., a Silicon Valley start-up company that pioneered the development of hardware and software technologies used in the design of information appliances. Diba was acquired by Sun Microsystems in August of 1997. Mr. Wolff holds a B.S. in Engineering Science from the California Polytechnic University of California at San Luis Obispo.

Sun Microsystems, Inc. 4150 Network Circle, Santa Clara, CA 95054 USA **Phone** 1-650-960-1300 or 1-800-555-9SUN **Web** sun.com

The Network is the Computer™

Sun Worldwide Sales Offices: Argentina +5411-4317-5600, Australia +61-2-9844-5000, Austria +43-1-60563-0, Belgium +32-2-704-8000, Brazil +55-11-5187-2100, Canada +905-477-6745, Chile +56-2-3724500, Colombia +571-629-2323 Commonwealth of Independent States +7-502-935-8411, Czech Republic +420-2-3300-9311, Denmark +45 4556 5000, Egypt +202-570-9442, Estonia +372-6-308-900, Finland +358-9-525-561, France +33-134-03-00-00, Germany +49-89-46008-0 Greece +30-1-618-8111, Hungary +36-1-489-8900, Iceland +354-563-3010, India–Bangalore +91-80-2298989/2295454; New Delhi +91-11-6106000; Mumbai +91-22-697-8111, Ireland +353-1-8055-666, Israel +972-9-9710500 Italy +39-02-641511, Japan +81-3-5717-5000, Kazakhstan +7-3272-466774, Korea +822-2193-5114, Latvia +371-750-3700, Lithuania +370-729-8468, Luxembourg +352-49 11 33 1, Malaysia +603-21161888, Mexico +52-5-258-6100 The Netherlands +00-31-33-45-15-000, New Zealand–Auckland +64-9-976-6800; Wellington +64-4-462-0780, Norway +47 23 36 96 00, People's Republic of China–Beijing +86-10-6803-5588; Chengdu +86-28-619-9333 Guangzhou +86-20-8755-5900; Shanghai +86-21-6466-1228; Hong Kong +852-2202-6688, Poland +48-22-8747800, Portugal +351-21-4134000, Russia +7-502-935-8411, Saudi Arabia +9661 273 4567, Singapore +65-6438-1888 Slovak Republic +421-2-4342-94-85, South Africa +27 11 256-6300, Spain +34-91-596-9900, Sweden +46-8-631-10-00, Switzerland–German 41-1-908-90-00; French 41-22-999-0444, Taiwan +886-2-8732-9933, Thailand +662-344-6888 Turkey +90-212-335-22-00, United Arab Emirates +9714-3366333, United Kingdom +44-1-276-20444, United States +1-800-555-9SUN or +1-650-960-1300, Venezuela +58-2-905-3800, or online at sun.com/store

SUN™ THE NETWORK IS THE COMPUTER © 2005 Sun Microsystems, Inc. All rights reserved. Sun, Sun Microsystems, the Sun logo, Java, J2ME, J2EE, iForce, Solaris, StorEdge, "Write Once, Run Anywhere," and "The Network is the Computer" are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the U.S. and other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc. UNIX is a registered trademark in the United States and other countries, exclusively licensed through X/Open Company, Ltd. Other brand and product names are trademarks of their respective companies. Information subject to change without notice.