

The Road to Profit is Paved with Data Revenue

**QUALCOMM Internet Services White Paper
June 2002**

“ In the first three months of our BREW-enhanced magic n’ multipack service, we saw an increase in average data revenue per user of 9 percent* across our entire subscriber base. ”

**Dr. Won-Pyo Hong
Executive Vice President
New Business Group
KTF**

170,000 BREW magic n’ multipack users driving data ARPU up 9% across a KTF subscriber base of 9.5 million users.

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Executive Summary

“The launch of an advanced application platform for wireless devices in North America is a watershed event for companies like JAMDAT Mobile. In the BREW environment, we're able to charge directly to the end user for our applications and to receive the lion's share of those revenues, which allows us to invest more heavily in the kinds of high-quality content we think consumers are really going to embrace.”

*Mitch Lasky
CEO
JAMDAT Mobile.*

For mobile wireless network operators, the road to profit has always included providing services their customers find valuable, and to a certain degree addictive. To date, voice has been the leading application on mobile wireless networks. But it is clear that non-voice services (data applications) offer an enormous opportunity – if operators provide them in a way that's operationally efficient and has mass-market appeal.

These data applications include instant messaging, games, news, entertainment and productivity enhancement tools, to name a few. They may also include applications that allow network operators to more effectively communicate with and retain their customers, such as those that customize user interfaces and update handset-dependent network features. New voice-based applications – voice recognition and push-to-talk capabilities – are emerging as well.

The best way for the wireless industry to deliver these applications to customers is through a solution that:

- Is open, globally standardized, hardware independent and consistently deployable on any network and on any mobile device.
- Provides an end-to-end solution, encompassing both an open technology platform and a well-developed business model for revenue sharing along the entire value chain.
- Includes a method for discovering, buying, downloading and managing applications on client devices.

QUALCOMM's Binary Runtime Environment for Wireless™ (BREW™) platform and the BREW Distribution System (BDS) provide the only commercial technology and business system that can fulfill these requirements. The BREW platform provides the kick-start needed to fuel mass-market adoption of wireless data applications and services.

BREW Overview

“The ability to extend our wireless content into the United States is a tremendous business opportunity for our company. Now consumers in the U.S. can enjoy the variety of entertaining games that we developed for KTF’s magic n’ multipack subscribers.”

*Ji Young Park
CEO and President
Com2uS*

The BREW platform is the only open and end-to-end solution that provides a path for data profit to application developers, device manufacturers and network operators. It is both a technology *and* a flexible, turnkey business system.

With BREW, technology and time-to-market barriers are lowered. Handset manufacturers, network operators and application developers all benefit from being able to efficiently develop, deploy, buy and sell new data applications.

- The learning curve for **application developers** is minimal because the BREW platform is based on C/C++, a familiar and popular programming language, and downloading the BREW SDK™ (software development kit) is free. The BREW business model gives developers a convenient way to offer their applications to all participating global network operators simultaneously.
- For **manufacturers**, adding BREW to a device is surprisingly easy. The BREW platform requires little memory on the phone, which makes it more easily ported to memory-constrained lower-cost phones that appeal to the mass market – a critical factor since 80 - 90 percent of mobile phones sold are in the “low cost” category according to The Shosteck Group. Manufacturers bear no out-of-pocket cost to add BREW to handsets they’re shipping to network operators offering BREW-enabled services.
- **Network operators** can choose from a catalog of applications that will work with all BREW-enabled phones, and the optional TRUE BREW™ compatibility testing process, which QUALCOMM provides at the request of the wireless operator, ensures these applications are secure and reliable.

Revenue opportunities for all wireless industry stakeholders will be realized through BREW, because it provides a technology and business engine that will drive a strong consumer wireless market and pave the road to profit for developers, manufacturers and operators.

Client-side Applications

Client-side execution enables interactive, personalized and real-time services that provide tangible benefits to mobile subscribers.

Mobile phones have become like a computer in the hand – capable of running a variety of applications. Yet this capability is constrained by market demands that require mass-market phones to be small, inexpensive, light and consume little power. These constraints, in turn, have restricted device processing power and memory (storage).

The historic approach to delivering applications to phones has been to shift processing power to servers in the operator’s network, or to a third-party company via the Internet (known as *server-side* execution.) Portals and mobile games using WAP browsers exemplify this strategy. Content and applications are generated by remote servers, passed through the network and displayed in the browser on the mobile phone. The user then keys in responses to choices displayed on the device screen, which are sent back through the network to the server for processing and response.

The weaknesses of the browser-based server-side approach are clear: high latency and limited interactivity on the mobile device. This makes the most exciting, graphic-rich interactive games impossible – and these games represent the bulk of gaming activity on other (non-wireless) handheld platforms. In effect, with a browser-based solution that requires server-side processing, the mobile phone becomes an unnecessary performance bottleneck and prevents the best applications from being developed because of its inability to process information locally.

However, decreases in size, power consumption and cost of silicon chips have enabled a second approach – putting more processing power on the mobile device. This opens up a new range of applications based on local, or *client-side*, processing. This is expected to be the predominant growth area for new mobile wireless applications – rendering today’s slow server-side approaches virtually irrelevant for many new types of applications.¹ Rather than only using the browser on the mobile phone to run and interact with applications, it becomes a true platform for software applications that can offer a startling array of new consumer data services provided by the network operator.

¹ Shosteck Group study, “Mobile Phone Games: The Market Through 2005,” Wheaton, Maryland, November 2001.

QUALCOMM's BREW platform and Sun Microsystem's Java technology (implemented on mobile phones as J2ME) are two popular technologies that support client-side processing. Both technologies offer a method for executing software applications on a mobile device.

Contrary to popular belief, BREW and J2ME technologies can run together on the same phone. The BREW platform supports J2ME and gives J2ME developers added value through its end-to-end system approach. The BREW platform also offers specific advantages in efficiency, device integration, power consumption, functionality and cost.

Advantages of BREW's client-side processing technology include the following:

- **True real-time processing.** With client-side processing, a new range of applications (such as action games) will be developed because of the BREW platform's ability to download and run applications locally on the phone. Even on circuit-switched networks, applications start immediately since they reside on the phone – with no need to wait for a data call to be initiated.

BREW extends this advantage by offering true real-time processing, enabling other applications – especially those that are voice-based applications.

- **Fast interactivity with information.** With client-side execution, customers can download a database of travel information about a specific locale to their devices in just a few seconds, then search the database or interact with maps quickly and as often as needed. The locally stored information can also be used to enhance position information for personalized location-based services. All customers enjoy equally fast application response times regardless of network bandwidth.

BREW enhances client-side execution by tightly integrating with the phone's basic telephony functions. It's simple for a developer to write applications that take advantage of BREW's telephony management features, so an application can be automatically suspended and then resumed in the event of an incoming call or SMS message.

- **A more personalized mobile experience – over the air.** End users can literally customize their phone with applications and information that suits their lives – and change the applications as often as they wish. One customer might personalize his or her handset by downloading all business productivity applications (a financial calculator, a stock-tracking application and a streamlined contact database), while another might download entertainment applications and a personalized ring tone. And it can all be done over the air – no cables or PC connection required.

The BREW application platform allows network operators to install, recall and update applications over the air. Even in the case of telephony-specific applications, there is no need to bring the handset into a store or operator location for servicing.

- **Minimal hardware and software requirements.** The BREW platform is thin – ~150k – efficient and powerful, and there’s no need for a separate virtual machine (VM) for each model of phone. Carriers who wish to have both J2ME and BREW on a handset will only need one VM, and over time they will have access to multiple VM options. Currently, IBM is porting its WebSphere Micro Environment (formerly know as J9) to BREW, and HP has ported its MicroChai environment to BREW. This opens the door to porting other companies’ VMs as well.

BREW naturally supports client/server-based applications, such as multi-player gaming, just as elegantly as client-side applications. For further discussion, refer to the “Networks and Network Operators” section of this paper.

Going Beyond “Run Anywhere”

An application execution platform alone is not enough – BREW integrates application testing, provisioning, execution, purchase and support.

It’s great to have client-side applications running on mobile phones, but it’s not enough. It is absolutely critical to have an open, flexible model for discovering, buying, downloading, managing and billing for applications on client devices.

Consider a customer with a device that offers these capabilities, and imagine that a new entertainment application has been developed for which this customer is an ideal prospect.

To begin, the customer should be able to easily check for new applications from their handset (not from a PC). The network operator's supporting server software should verify that the application will run on the customer's phone (to avoid disappointment) and that memory is available on the phone to download the application.

Next, the customer must be able buy or try the application, which entails several steps for the underlying software: (1) determining the price and other information (for example, an expiration date on the application or free trial offer), (2) offering them the choice to download and (3) creating a billing record that integrates with the operator's existing billing system once the download is complete and successful. To the customer, this process should be easy, self-explanatory and quick – taking just a matter of seconds.

Once the application is downloaded, it must be installed. This includes adding it to the customer's personal list of available applications, and afterward, allowing the customer access. The installation process should be seamless and invisible to the user.

Furthermore, a good customer experience requires certain management capabilities, including the ability to remove the application if needed to regain storage space and view information regarding the storage space consumed by each application. In the event an application needs to be updated or recalled, the network operator should be able to recall and update the application over the air without user intervention.

Figure 1: Mapping BREW to end-to-end solution requirements

	BREW platform
Application Discovery and Verification of Compatibility	✓
Application Testing at Carrier Request	✓
Purchasing (M-Commerce) Process	✓
Downloading	✓
Billing Record Creation	✓
Installation / Execution / Deletion	✓
Over-The-Air Recall and Update	✓

As shown in Figure 1, the BREW platform provides all the capabilities – and more – required of a truly complete end-to-end solution.

The goal is a good customer experience – and a functional model that does not leave gaps. BREW provides both. These requirements demonstrate a need for a platform that is more than just an execution environment. Testing, provisioning, purchase and customer support all contribute to a complete solution. Only BREW meets all these requirements without additional integration or third-party software.

Value for All

It's critical to know exactly how network operators, their customers, and their vendors will be able to profit together. BREW is the only solution that enables this without third-party integration.

The wireless value chain is growing longer and more complex as services evolve from voice to data applications. And a value chain that doesn't offer a viable revenue opportunity for all stakeholders is a chain that will break. Only with profits for application developers, network operators, device manufacturers and others, can new services and useful, relevant applications proliferate. The BREW platform ensures that everyone has a method and opportunity to offer value and receive a share of revenue.

While it is possible to develop technology to deliver value, it is a considerably more complex problem to ensure a realistic value chain. The Internet provides an example: protocols such as HTTP provided a method for delivering free World Wide Web applications and services to users but included no mechanism for reimbursing content providers. The problems of reimbursement and profitability had to be worked out over a period of years, during which thousands of companies failed and billions of dollars were lost. Overheated publicity and incomplete solutions can stall a market.

For network operators who have to justify expensive network development and spectrum fees, a slow and uncertain approach is not an option. The same is true for application developers and for manufacturers of devices and hardware – both have limited resources and a broadening range of technologies to support.

Any approach to providing new data services must therefore begin with a well-developed plan for revenue sharing along the entire value chain. From the outset, BREW has met these criteria and differentiated itself as both an open technology approach and as a complete business model.

Global Applicability

To be competitive in the worldwide wireless market, a technology must provide economies of scale and a consistent user experience across networks. This is the difference between standardized and standards-based approaches. “Standards-based” generally implies custom integration or integration according to loose specifications. An example is today’s medley of protocols and standards such as WAP, SyncML and MMS – which are now being combined in various ways with other software by various network operators.

Solutions that integrate a collection of off-the-shelf technologies in custom configurations leave room for inconsistencies between networks, which make interoperability, roaming and a consistent customer experience virtually impossible. Ad hoc solutions also make achieving reasonable economies of scale difficult due to varying requirements for device hardware and software. All of these factors dilute developer and manufacturer support, and ultimately deteriorate the viability of new services.

Such islands of technology will not succeed in the increasingly complex world of data services. To be effective across real-world network deployments around the world, technology solutions must be standardized, consistently deployable on any wireless technology and on virtually any mobile device – from mass-market phones to high-end PDAs – while providing the customer with a uniformly excellent experience.

BREW's Value Proposition

Increased ARPU is the key to success. When customers see new services that really deliver value, ARPU increases and everybody in the value chain profits.

The BREW platform provides unique advantages over any other solution available, to meet both market and technology requirements. From the ground up, BREW is complete in its specific attention to supporting the requirements of the entire value chain.

Foremost, BREW offers the opportunity for increased average revenue per user (ARPU) in a way that preceding technologies, such as WAP, have been unable to achieve and sustain. The reason is simply that BREW enables higher value applications to be created and provides a revenue-generating marketplace for more applications to be developed in the future.

WAP has added some incremental revenue from existing voice customers. But customers' perceived value of the service has been low. It has failed to gain significant adoption and many operators have been forced to give away WAP service and subsidize phones in an attempt to stimulate use. Even with time, the impact on ARPU will likely be minimal due to the continuing constraints imposed by the WAP solution (and solutions layered atop WAP, such as M-Services).²

Increasing ARPU is the key to a complete value chain. If the customer isn't willing to pay more for the new data services, nobody makes a profit. This can be seen in practice today as application and content developers for WAP-based services are failing to achieve profitability and are either quitting or moving on to other, more profitable platforms. Left unsolved, this problem will eventually lead to a dearth of meaningful services and a downward economic spiral. With a powerful platform that enables high-value applications and services that perform well, ARPUs will increase. The BREW applications execution environment is designed specifically to support development and provisioning of high-value applications on the kinds of mobile devices people use most today.

Increased ARPU is only the beginning. To be truly effective, a technology must support network operators, devices, application developers and users.

² Shosteck Group study, "WAP: The Value Chain Doesn't Stand Still," Wheaton, Maryland, May 2001.

Networks and Network Operators

BREW deploys on any 2G or later network – whether circuit or packet – and the customer experience is uniformly excellent.

The BREW platform is designed to provide a consistently excellent user experience regardless of network infrastructure. First and foremost, it is entirely agnostic – meaning that it deploys equally well on all leading wireless technologies.

The BREW platform also works well with existing circuit-switched networks, addressing the needs of operators who will not be building packet networks near term and those who will be deploying packet networks in stages. Whether the customer is on a packet network or circuit network, or roaming between the two, does not affect the quality of the customer experience. BREW can be an effective revenue-generator now, not only after expensive network technology upgrades.

This differs from server-side solutions such as WAP. Because they rely almost entirely on constant communications between the device and the application server, WAP requires a packet network for a satisfactory end-user experience.³ Even with a packet network, issues of latency are problematic. Latency gives the user the impression of a “slow network” regardless of actual bandwidth available. The BREW platform, because of its client-side execution capability, is independent of network latency. A better network increases what can be done with BREW, but regardless, BREW enables a good user experience with any existing 2G or later network. BREW applications can provide powerful services even without 3G networks.⁴

Equally important, BREW grows with network and device upgrades. Greater bandwidth and/or lower cost delivery mean that over time more robust applications can be downloaded and run more economically. This increases the perceived value of BREW-based applications from the customer perspective, and it capitalizes on the advanced capabilities of new networks as they are deployed. Additionally, as memory and processing power in devices increase, BREW applications will increase in their sophistication and can be provided to end users over the air. Obsolescence is a non-issue – BREW becomes increasingly useful and valuable over time.

³ Shosteck Group study, “WAP: The Value Chain Doesn’t Stand Still,” Wheaton, Maryland, May 2001.

⁴ 3G refers to UMTS and CDMA2000. However, for purposes of this paper, we do not distinguish between the technologies.

The impact of this on 2G and 3G network operators is tremendous. Envision one result of combining a packet network with BREW's client-side execution capability: massive multi-player games. Such games will run locally on the customer devices and will still use the wireless network and a central server for players to compete against others. The customer would pay for a downloaded game and would also pay for a narrow data stream over the wireless network during multi-player sessions.

With BREW-enabled multi-player games, players can enjoy an excellent real-time collaborative experience on their mobile devices, and yet require very little network bandwidth. It's the ideal profile for network operators: customers who pay for access but don't overload the network. Already top game companies such as JAMDAT Mobile, Digital Bridges and nGame are eyeing this format as an upcoming major opportunity in mobile play.⁵ JAMDAT Mobile and nGame are already publishing games for the BREW platform.

Applications that require real-time processing need BREW. Other technologies just can't deliver.

The BREW solution enables real-time execution applications. For instance, U.S.-based carrier Nextel decided to adopt QUALCOMM's QChat™ push-to-talk technology as the migration path to 3G for its "Direct Connect" service (currently based on Motorola's iDen). After evaluation of the available technologies, Nextel recognized that only QChat – by virtue of its tight integration with chipset software – could meet the real-time requirements of this demanding application. (QChat is push-to-talk communications technology for 3G CDMA networks that will enable virtually instantaneous push-to-talk functionality using a voice over IP (VoIP) architecture.)

Nextel's choice underscores other significant advantages of the BREW platform. After implementing QChat-based Direct Connect on BREW, Nextel can push QChat upgrades and expanded capabilities over the air without handset replacement. By developing these new telephony features with BREW, Nextel gives itself flexibility, avoids the risk of having to replace "buggy" hardware and can rapidly respond to future demands.

⁵ Shosteck Group study, "Mobile Phone Games: The Market Through 2005," Wheaton, Maryland, November 2001.

The BREW platform is a single, integrated and open end-to-end solution that includes application distribution and purchase. This reduces network infrastructure and integration costs, reduces time to market, and increases operational efficiencies for operators.

Perhaps the best part of the BREW platform is its low cost of implementation. BREW reduces costs and risk to network operators and enhances their operational efficiency in three ways:

- **Low infrastructure cost.** Operators have total control over how much and what they want to control, and can scale to demand. Their investment can start under \$100,000 to support up to 4 million users.
- **Lowered cost for other platforms.** Because the BREW platform provides the basics – application discovery, management, downloading, billing records, etc. – it supports a wide range of other applications and programming languages. Whether a microbrowser, a game, a ring tone, a voice application or even J2ME applets, the BREW platform gives operators the means to offer a wide range of services atop a single platform. This eliminates the need to implement proprietary platforms for every new service that becomes available – thus increasing efficiency and lowering costs.
- **Low risk.** With the BREW business model (discussed below), operators pay only for successfully deployed applications and services. Application developers are paid only for applications actually purchased by subscribers. Because of its small memory footprint, BREW handsets can be made less expensively. That means BREW can roll out to price-sensitive customers today – the same demographic market that made SMS a global success.

Devices and Manufacturers

BREW's tight integration with the chipset software results in faster application and device development – and greater execution efficiency (less memory and power required).

In the past, the “smart phone” concept led many to believe that feature-laden operating systems were the key to advanced data on mobile devices. But the experimental and niche phones based on operating systems from Geoworks, Palm™, Symbian and Microsoft have failed to attract volumes of users, in large part due to their exceptionally high prices. Operating systems are not an efficient solution for enabling wireless data.

Ideally, applications should be scaled perfectly with the various tiers of phone models and make efficient use of the phone's resources and provide a consistent user experience.

To succeed at this task requires a complete solution that addresses the needs of all devices – not just the high-end. The BREW application execution environment does this by virtue of being integrated with the processing chip in the Flash memory and RAM of mobile devices. Essentially, BREW provides a software connection between the low-level functions of the mobile device and the higher-level applications written by third parties. Because BREW functions as an abstraction layer in the Flash and RAM, BREW software developers do not need to intimately understand embedded systems programming. Instead, they're freed-up to focus on the design and creation of the application, not the underlying hardware.

The benefits of this approach are clear: streamlined and efficient software development. With BREW, porting applications from device to device becomes almost a trivial task. Time-to-market is vastly reduced, and new applications work consistently from one phone to another.

BREW's easy software porting makes BREW functionality readily available to all handset manufacturers. The BREW platform is air-interface independent and has been ported to CDMA IS-95A, IS-95B, 1x, 1xEV-DO and GSM/GPRS handsets. Of all available options for client-side processing, the BREW solution is the least expensive and easiest to implement, with the lowest requirements for phone design.

As mentioned previously, the BREW platform is ideally suited for lower priced phones, which account for most of today's mobile phone market. Because BREW only requires ~150k of memory for the complete system, more usable and interesting applications (that can be as small as 10-50k *per user application*) can be offered on lower tier phones. The low cost and simplicity of this chip-level integration means that BREW can realistically serve mass-market devices.

Perhaps most important, as of May 2002, 16 network operators had already publicly indicated their support for BREW – covering 81 million subscribers worldwide. Three operators, Verizon Wireless in the U.S., KDDI in Japan and KTF in Korea have already launched BREW services. The market for BREW-enabled mobile devices is rapidly gaining momentum.

Application Developers

Bringing new applications to market quickly is critical to the success of software developers. The BREW execution platform is based on the widely-used programming language C/C++, which has a base of more than 7 million application developers today who can support BREW with minimal additional knowledge of mobile phones. To begin the process, a developer can simply download the free BREW SDK from <http://www.qualcomm.com/brew/developer/developer.html>. At the time of publication of this paper, QUALCOMM had logged more than 12,000 SDK downloads.

Java programmers can also benefit from the chip-level integration of BREW. Java applications normally require a Java Virtual Machine (JVM) that is specifically designed for each device to handle chipset-level functions. For example, any application running on a phone needs to access basic telephony functions such as the arrival of an SMS message or access to a phone's built-in GPS capability. Because access to those functions varies from phone to phone, a special JVM would be required for nearly every model.

Every network operator defines their own specification for Java implementation (over and above the MIDP specification). Therefore, each manufacturer builds custom APIs to get better performance out of the MIDP 1.0 specification. The result is that each handset may require different JVMs and MIDP interpretations from each manufacturer.

Because BREW includes a complete solution for the distribution, download and purchase of applications, it eliminates the need for third-party integration to perform those functions for Java applications.

IBM has written a single JVM that acts as an extension to BREW. Java developers will be able to take advantage of this JVM to enable them to write Java applications once and run them on all BREW-enabled devices that have sufficient memory footprints, regardless of manufacturer. The BREW platform is standardized, so porting applications from one device to another is simplified. Additionally, BREW makes getting Java applications onto handsets much easier, and will enable upgrading and recalling JVMs over the air. Java applications will run on more phones, more easily, with BREW.

Essentially, BREW functions as the “lowest common denominator” to smooth the way for Java applications, and enables millions of C/C++ and Java programmers to offer software for mobile devices as well.

Finally, the BREW platform gives developers the ability to easily monetize their applications. The BREW solution includes a complete billing and payment infrastructure – the BREW Distribution System – that helps ensure developers receive the payment they deserve for their applications. No other platform solution offers this benefit.

Users

Customers want the simple, safe, reliable and uniformly excellent experience that only the BREW solution can provide – on handsets they can afford.

Mobile phone consumers occupy many market segments – from price-sensitive “security” users with inexpensive handsets to corporate customers with high-end devices, and from young people seeking entertainment services using prepaid handsets to international roamers with high monthly expenditures. A successful technology must address all segments of consumers.

BREW is integrated at the chipset level allowing network operators to provide meaningful applications to even the lowest-cost mobile phones. Lower costs means consumer-oriented phones can be more readily supported.

Lower-cost phones are critical to the prepay market. Even the most price-sensitive customers can have access to new applications on their handsets regardless of their method of payment. BREW is universally available to customers, even as they graduate from one handset to another and from one pricing plan to another.

The built-in “Mobile Shop” application allows BREW users to easily find, add and remove applications with just a few clicks on the keypad. And, there is no requirement to “synchronize” the phone with an Internet-connected computer.

The BREW platform enables a myriad of compelling and useful consumer applications and services on the mobile phone. These applications are dramatically better than the WAP- and SMS-based services of today. Applications written for BREW offer excellent graphics, fast-paced action and real-time interactivity. Information services give the user the ability to search information both locally (on the phone) and on the Internet, as part of a single, seamless process.

All of these features contribute to a complete customer experience. Complex technical barriers are non-existent, so customers don't feel they have to be tech-savvy, early adopters to enjoy new applications and services on their mobile devices. From a customer's point of view, it just "works" – without crashes, incompatibilities, security risks or confusing instructions – and gives them new services that are worth paying for.

An Integrated Business Model

The BREW solution takes a holistic approach to the business model. BREW is free to handset manufacturers, free to developers, low cost for operators and includes both a complete technology solution and business model.

The BREW application execution environment answers technology requirements by:

- Providing a uniform and interoperable method for discovering, buying, downloading and managing applications on client devices – including Java applications;
- Serving all wireless technology standards and virtually any mobile device;
- Enabling mass-market devices more quickly, tightly integrating with the device chipset and efficiently supporting real-time applications.

With BREW, application developers can easily market their software, and network operators can quickly bring safe, high-quality applications to market.

Distribution, management and the sale of BREW applications are the core of the BREW business model. It includes a virtual marketplace for developers and network operators to buy and sell applications. Application developers submit their applications for testing (see discussion below). Once approved and digitally signed, the applications become available to network operators. Application testing is made available to operators, and BREW applications are tested at their request. The operators select the applications they want to offer to their customers and negotiate a price directly with the developer.

Operators and application developers determine wholesale prices of applications. This price is split between the operator, the developer and QUALCOMM. (The “wholesale” application price does not include any additional fees levied by the operator for airtime or a retail markup.) The price is paid per user purchase – meaning that payment is triggered by success. In this way, all three parties earn revenue for their share in building valuable new services that customers actually use.

The network operator can choose a retail price that makes sense for the application and the market. In some cases, the network operator might mark up the price for additional profit. In other cases, such as an advertiser-subsidized application, the operator could offer the application for free or at a reduced price. The operator is in control of what applications are available and what they cost – and can design an offering that best suits the demands of its customers.

QUALCOMM supports the operator with back-end software and the BREW Distribution System. This modular system includes a download server, transaction manager, carrier and developer extranet, and application manager. It integrates with the network operator's existing billing system, providing a seamless, flexible, inexpensive and complete architecture to enable BREW application distribution.

The BREW model greatly simplifies the task of finding markets and getting applications to market for developers. The BREW ecosystem offers a convenient global marketplace for contacting customers, selling applications and collecting payments. Rather than having to bill each operator separately, the application developer collects his share directly from QUALCOMM.

Similar advantages accrue for network operators. Not only can they reduce costs by selecting new services from the pool of pre-tested BREW applications, but the BREW model also ensures they only pay for applications when customers actually download them. Additional revenue can be secured from airtime charges, added-value service fees, sponsorships and content.

Reliable, High-Quality and Safe Applications

Pre-screening applications to ensure quality and to protect customers and the network is imperative. Only the BREW platform builds this into the core technology and business model.

The new mobile environment with downloadable applications will have new challenges such as the frustrations of viruses, hackers, poor usability and software crashes.

NTT DoCoMo has faced this problem head-on since its introduction of Java-based phones. Immediately after launch, hackers discovered weaknesses in the platform that allowed them to email viruses to other phone users. These viruses can cause the phone to power off, lose data and dial emergency services.

The inevitable result is two-fold: First, the customer becomes disenchanted with the service (and tired of frequent warnings from the network operator), and hence is reluctant to trust the phone or the operator. Second, the network operator is forced into a role of reactively screening and patching to stop viruses as they appear – an expensive, unreliable, and ultimately frustrating approach.⁶

In addition to hacking and viruses, poor quality (but benign) applications also degrade the perceived value of service offerings. Customers expect services to work reliably and predictably. Poor quality applications, even those provided by third parties, reflect badly on the overall service offering.

To protect the value of the service offering, it is imperative that some method be implemented to protect the customer from malicious or low-quality applications while simultaneously enabling choice. Here, BREW excels by bundling its core technology model with a process to ensure quality. Applications, at an operator's request, may be thoroughly tested by National Software Testing Laboratory, an independent testing firm, before they are implemented on mobile networks.⁷

While manufacturers of Java phones are also launching certification programs, these programs are not standardized across all implementations of J2ME MIDP. That means that one manufacturer's certification of a Java phone may not meet the standards of another manufacturer.

Only BREW applications are digitally signed by the developer, by QUALCOMM and by the network operator using a VeriSign-generated class III Internet certificate. This identifies the author (preventing the anonymous applications that are currently plaguing NTT DoCoMo), verifies they have been tested, and shows the network operator has approved them for use on the network. The BREW software environment on the mobile device looks for those digital signatures and will not allow the download or execution of any application that has not been correctly signed. As a result, BREW applications are secure and reliable – and they build trust and value in the eyes of customers.

⁶ NTT has advised users not to accept emails from unknown sources. "Phone Viruses," Wireless Internet, p. 19, December 13, 2001.

⁷ National Software Testing Lab (NSTL) is QUALCOMM's partner in testing of BREW applications. NSTL is a global leader in IT testing, planning and consulting. They act as an independent testing company to run the tests for applications to qualify as TRUE BREW tested.

Summary

Only the BREW platform forms a complete, open solution that encompasses the full range of market requirements, including:

- The ability to provision, download, sell and manage applications without custom systems integration.
- High-value applications that increase ARPU, including real-time applications.
- A good customer experience on any network, and in any payment mode.
- The ability to work well on lower-priced, mass-market handsets in addition to high-end, feature-rich phones.
- Minimal barriers to entry, including a low learning curve for developers, no cost to manufacturers, minimal cost to operators and easy implementation.
- No need to re-write code to access core functions of different model devices.
- An integrated method to ensure the quality, security and reliability of applications.
- A guaranteed revenue model for network operator and application developer.

The BREW platform is uniquely positioned to enable the mobile applications of the future, while supporting the technologies and business requirements of the wireless industry.

DISCLAIMER:

Strategic advice and research for this paper was provided by The Shostek Group, an independent international telecommunications consultancy specializing in the wireless industry.

Appendix A

Network operators that have indicated support for the BREW platform (as of May 2002):

ALLTEL	Pegaso
BellSouth in Guatemala	Saskatchewan Telecommunications
Iusacell	Telcel-Bellsouth
* KDDI	Telesp Celular
* KTF	U.S. Cellular
LEAP Wireless International	China Unicom Horizon
LG Telecom	* Verizon Wireless
Movicom	Vesper

**Have already launched.*

Appendix B

Handset manufacturers that have indicated support for the BREW platform (as of May 2002):

Appeal	Panasonic
Curitel	Samsung
Denso	SANYO
Hanwha	Sharp
Hitachi, Ltd.	Synertek
Intercube	Telson
KTF Technologies	Toshiba
Kyocera	ZTE
LG Electronics	