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Android: Changing the Mobile Landscape

Margaret Butler

The mobile phone landscape changed last year with the introduction of smart phones running Android, a platform marketed by Google. Android phones are the first credible threat to the iPhone market. Not only did Google target the same consumers as iPhone, it also aimed to win the hearts and minds of mobile application developers. On the basis of market share and the number of available apps, Android is a success.

ANDROID PHONE MARKET GROWTH

Google partnered with multiple handset vendors and service providers, giving consumers choices the iPhone doesn't. HTC, Samsung, and LG each have at least one Android phone offering. Because Google offers Android as an open source solution, any handset manufacturer can use it as a software development platform. Sprint, Verizon, T-Mobile, and AT&T provide phone services for a variety of Android phones, unlike iPhone, which is limited to AT&T. Giving consumers choices has clearly paid off for Android: as of September 2010, Android-based smart phone sales numbered 200,000 per day, versus 80,000 per day for iPhone iOS 3 and 4.[1]

Figure 1 shows BlackBerry unit sales' steadiness over seven quarters—5 to 6 million per quarter. iPhone's unit sales hovered around 3 million per quarter for six quarters, but grew to nearly tie BlackBerry in Q3 2010. Only Android's sales show significant growth each quarter for the past seven quarters.[2] Canalys senior analyst Pete Cunningham says,

> *Android has been well received by the market. … Vendors are now delivering Android devices across a broad range of price points, from high-end products, such as the Samsung Galaxy S or HTC Desire, to aggressively priced devices, such as the LG GT540 Optimus or the Huawei-built Vodafone 845, ensuring that Android devices are available and affordable to consumers on almost any budget.*[3]

As Figure 1 shows, Android was the only phone with significant Q2 2010 growth, beating iPhone sales and tying BlackBerry. From Q2 to Q3 2010, both Android and iPhone grew by 61 percent. Figure 2 depicts the current market share for North America. In Q3 2010, Android became the market leader, surpassing both iPhone and BlackBerry,[2] and now leads with a 39 percent market share.

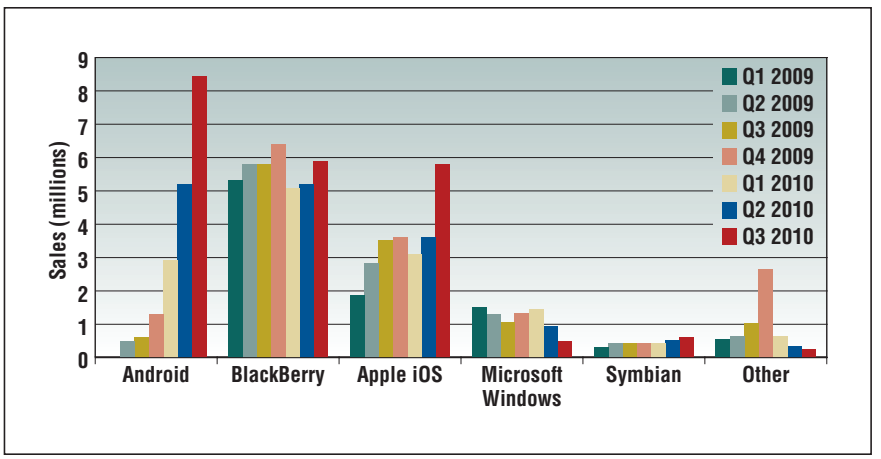

Figure 1. North America smart phone unit sales by quarter. Only Android's sales show significant growth each quarter for the past seven quarters.

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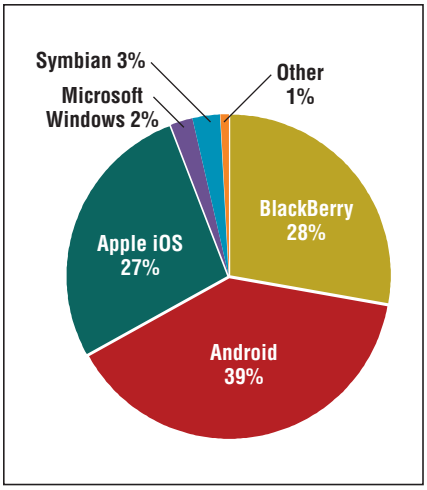

Figure 2. North America smart phone OS market share, Q3 2010. In Q3 2010, Android became the market leader, surpassing both iPhone and BlackBerry, and now leads with a 39 percent market share.

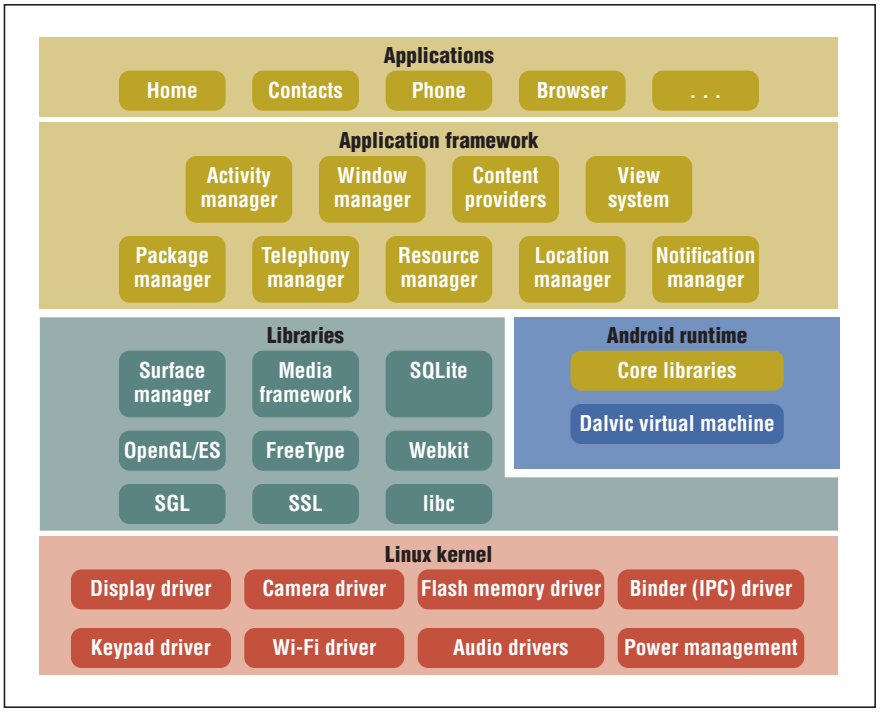

Figure 3. Android system architecture. The Android software stack contains Java applications on top of a Linux kernel.

THE ANDROID SOFTWARE PLATFORM

The Android operating system is built on a modified Linux kernel (see Figure 3). The software stack contains Java applications running on a virtual machine, and system components are written in Java, C, C++, and XML.

Android phones ship with a rich array of built-in activities (the Android term for services), including email, a Web browser, and a map application. The platform embraces a replace-and-reuse philosophy, which lets users customize the phone. For example, Android phones come with a built-in photo viewer, which all applications that view photos use. However, users can replace the photo viewer with a customized one, and all applications will automatically call the customized one. All applications use (or reuse) the same activity. This is an example of the system's open design.

APPLICATIONS AND DEVELOPERS

Mobile applications are changing how people experience computing and use mobile phones. A decade ago, people used cell phones only for making phone calls; PDAs stored important information such as contacts and calendars; and PCs performed tasks such as accessing the Internet, reading email, editing documents, and playing games. Owing to mobile applications' power and richness, today's smart phones provide the same computing power and similar capabilities as the PCs of a decade ago. Smart phones are becoming central to our communication and information needs. A smart phone's ability to complement our lives is directly related to the richness and quality of its mobile applications.

Much of the iPhone's value and success is attributed to the breadth of its applications. As of October 2010, according to Apple, consumers had more than 250,000 apps to choose from in the Apple App Store. According to AndroLib (www.androlib.com), the Android Market offers more than 150,000 applications and has been growing steadily by more than 15,000 per month for the past five months. Users have downloaded approximately 2 billion apps from the Android Market. Many new applications come out simultaneously for iPhones and Android phones.

A key difference between the Android Market and the Apple App Store is that the Android Market is open, whereas the Apple App Store is gated. That is, developers self-publish to the Android Market, whereas developers must submit applications for publication to Apple, and Apple decides what gets published. Google follows an egalitarian, open model for the Android Market. Developers see this as a significant advantage that lets them control publication. So, more applications will be available to consumers because publishing them is easier. The disadvantage is that the Android Market, and therefore consumers, might be inundated with low-quality applications, making finding high-quality applications more difficult. Android developers and Google are aware of this disadvantage and are seeking mechanisms that enable high-quality apps to rise to the top. At this point, they haven't found a satisfactory solution.

SMART PHONES

SECURITY AND PRIVACY

From an architectural viewpoint, Android applications are safer than iPhone applications.[4] Each Android application runs in its own space and can't access data from other applications without explicit user permission. iPhone applications can access many system resources by default, thereby letting the applications access user information without user permission. Because users control which services an Android application can access, they control their own security and privacy. On the other hand, iPhone users must trust that Apple has thoroughly evaluated each application before publishing it.

Although Android puts the control in the users' hands, users aren't necessarily protected from malicious applications.[5] For example, if users download an ad-based application that sends text messages to and receives messages from friends, they must give the application access to

- personal information (to read contact data),
- all messages (to read received messages),
- network communication (to download ads from the Internet), and
- services that cost money (sending messages can incur charges).

A legitimate application will use these services only for the intended purposes, but malicious software could use them to communicate personal information to a website. Users don't control what the application does with the services. Because the Android Market is open, people can easily create and market Trojan horse applications. Google removes apps from the Android Market that are identified as malware, but a user must determine that an application is malware, and the application could do harm before it's removed. To date, no malware has been reported doing serious harm, but analysts suspect this will be an issue for Android phones in the future.

APP INVENTOR FOR ANDROID

In July 2010, Google announced the public beta release of the App Inventor for Android (AIA) visual programming environment. AIA aims to make mobile-application development accessible to anyone. Hal Abelson, an MIT professor who led the AIA project, writes,

> *Ten years ago, people's use of computing was largely dissociated from real life. … [A Google collaboration with several colleges and universities involving AIA] is motivated by the vision that open mobile platforms like Android can bring some of that same change … to make it more about people and their interactions with others and with the world around them. It's a vision where young people—and everyone—can engage the world of mobile services and applications as creators, not just consumers.*[6]

Because users control which services an Android application can access, they control their own security and privacy.

AIA should enhance learning experiences in computing.

Creating an AIA application involves two stages: designing the user interface with the component designer and creating the application behavior with the blocks editor. The component designer is a webpage that lets the implementer drag and drop components onto a mock phone screen. The blocks editor lets the implementer attach behaviors to the components. An Android application is event driven, so the behaviors associated with components—such as button clicks, timer events, and item selection—are also event driven. Although the metaphor is simple, developers can use AIA to create complex applications.

In fall 2009, several universities used an alpha version of AIA to teach courses for non–computer science majors. At Mills College, Ellen Spertus taught Technology for a Better World, which examined how information and communication technology have improved the lives of politically and economically disempowered people around the world. Students learned to program in AIA, and their final project was to create a socially beneficial application. At the University of San Francisco, Dave Wolber taught Computing, Robots, and the Web, in which mobile phones replaced mechanical robots as the platform of choice for giving students hands-on programming experience. This course culminated in a final project wherein students created a new app using AIA. Through courses such as these, university students who aren't computer science majors have become excited about what they can do with technology. Thus, these courses are engaging a whole new audience in technical discourse.

AIA has been in public beta release for less than six months, yet more than 7,500 people belong to the developer discussion group and more than 250 people belong to the instructor discussion group. This tool is well suited to introduce programming concepts.

THE TECHNOVATION CHALLENGE

AIA was used in the Technovation Challenge, a program encouraging young women to become high-tech entrepreneurs. In spring 2010, 45 female high school students and 20 professional women mentors began a nine-week journey wherein they learned entrepreneurial skills and how to cre-

ate mobile phone applications using AIA. On the first day of using AIA, the students—most with no programming experience—created a simple app and had it running on their phones in 45 minutes.

The program culminated with a team challenge: create and pitch a new mobile application. Teams of students, working with mentors, created, designed, and prototyped innovative applications. Using their new entrepreneurial skills, each team pitched their app to a panel of judges (venture capitalists and entrepreneurs) who chose the winner. The winning app, MashUp, was developed for the Android Market, and each member of the winning team received a US$1,000 college scholarship.

At the program's end, participants were excited about what they could do with their mobile phones. One parent said, "My daughter never thought she could do anything technical; now she *knows* she can." The ease with which people with no technical training can create applications using AIA will allow more people to create mobile services.

According to Gartner, smart phone sales are increasing faster than feature-phone sales (96 percent versus 26 percent).[7] Although in Q3 2010, smart phone sales accounted for only 19.3 percent of worldwide mobile device sales, with such a high growth rate, smart phones will eventually overtake feature phones. Among smart phones, the market segment based on the Android operating system is growing the fastest. Android is already the leader in North America; analysts predict it will be the world leader by 2014.[8,9]

Android's future looks promising, but some issues need resolving. Google must address problems regarding the Android Market applications' quality and strengthen how applications can guarantee Android users' security and privacy.

AIA makes building Android applications easier, which will make the Android Market richer but also make distinguishing quality applications more imperative. AIA is democratizing the application development landscape; letting more people create content will enrich the mobile market.

Google is successfully marketing Android as the open choice—open source, many handset choices, multiple phone service options, and an open developer market. Google must determine how to be open yet control the quality of the user experience. If Google resolves these issues and developers continue to create quality applications for the Android platform, Android will be the clear winner. P

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