Don't Leave Quality Behind in Mobile App Testing

Introduction

Mobile devices are poised to challenge PCs as the application platform of choice, with 412 million mobile internet devices expected to ship in 2012 compated to 139 million PCs. Businesses in the United States alone are expected to spend $11.6 billion on mobile applications that year, with 30 million young Americans signed up for mobile social media applications by that time.

To tap this growing market, developers are creating applications that enable everything from mobile check deposits to location-based advertising. But the commercial success of these applications depends on their working smoothly and securely on a wide variety of handheld devices and wireless networks. Performing such testing quickly and cost-effectively greatly expands the market for such applications. But the complexity of the mobile hardware and software environment makes such testing vastly more complicated than for applications designed for PCs.

This white paper describes the unique complexities facing mobile application testers. It then suggests specific methodologies and tools that, based on Cognizant's experience testing mobile applications for global customers, balance the need for a quality user experience with the business requirement to deliver applications to the market in the shortest possible time.

Challenge One: Hardware Complexity

In the PC world, testers have essentially only one central processing unit platform (x86-compatible microprocessors) on which they must test applications. Most of the other hardware components that go into a PC or Mac, such as the disk drives, graphics processor and network adapters are usually thoroughly tested for compatibility with those operating systems and pose a relatively minor risk of problems. Their display formats also fall within a relatively narrow range of choices, and the input devices (mostly keyboards and mice) are well-known and familiar.

But mobile voice and data service carriers differentiate themselves by offering a dizzying range of handsets, each with unique configurations and form factors that can have unpredictable effects on the performance, security and usability of applications. Various handsets are built around a wide variety of processors, running at various speeds with widely varying amounts of memory, as well as screens of different sizes operating at different resolutions and in different orientations (landscape, portrait or both.)

Today's mobile handsets also contain a greater, and a more rapidly-changing, variety of hardware than the typical PC. These components may include Wi-Fi and Bluetooth network capabilities (along with, of course, cellular connectivity), an FM radio, a camera and in more and more cases a GPS receiver and even an accelerometer, which senses the movement of the device to reorient the display from portrait to landscape. Many handheld devices rely on multiple digital signal processors (one to handle voice communications, the other to process the audio, video and images associated with applications), as well as multiple input devices, such as a touch-screen and a keypad. Each combination of components interacts in different ways with each other, and with the operating system, to create potential compatibility and performance issues that must be addressed in testing.

In addition to these hardware-based concerns, the tester must cope with the complexity of the software environment. To assure an application will work on most customers' PCs, a tester need only test it on the most popular current versions of the Windows, Apple Macintosh and Linux operating systems. To assure performance on the same range of mobile devices, a tester must address all current versions of the iPhone, Windows Mobile, Symbian, Android, iPhone and RIM Blackberry OSes, as well as the Maemo OS developed by Nokia.

The handheld OS market is not only more splintered than that for PCs, but is also changing much more quickly. For example, as little as five years ago Palm was one of the dominant operating systems for mobile devices, but its influence is rapidly fading in favor of, for example, the iPhone OS. Such changes require that testers maintain knowledge of the test tools required for an ever-changing cast of operating systems.

Such complexity continues throughout the entire mobile software stack. Various devices might utilize runtime environments ranging from J2ME to the .NET Compact Framework or BREW. Developers can also choose among different rendering standards, such as HTML, WML, WAP 1.2, WAP2.0, cHTML and xHTML. Testers must also build and execute scripts checking the interaction among the various applications on the handset, as well as between the application and components such as the camera, microphone, charger, Bluetooth, Wi-Fi and cellular radios.

Finally, applications must be tested for their compatibility with any of the networks on which any given device might run. The networks operated by different carriers provide various levels of bandwidth, sometimes even within the same session as the user moves among cells or coverage areas. Different carriers use different methods to tunnel their own traffic into the TCP IP protocol used by the Web, changing how applications receive, transmit and receive data. They also use different Web proxies to determine which Web sites their users can access, and how those sites will be displayed on their devices. All of these differences can affect the stability, performance or security of a mobile application, and must be tested to assure the end-user experience.

Just as mobile operating systems are constantly changing, so are the networks, protocols and other key elements of the infrastructures used by the network providers. Carriers worldwide are upgrading their networks from 2G to 3G, and even to 4G with LTE (Long Term Evolution) networks.

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Finally, in order to be certified by carriers or handset manufacturers (and thus gain access to wider markets) applications may have to be tested for compliance with industry or carrier-specific standards. Each of these added test requirements increases the complexity, cost and time required to assure proper mobile application performance.

The picture is not all bleak, though. Testing that meets these challenges helps speed an application to market by reducing time-consuming rework at later stages of the development process. Studies show that finding and fixing defects after an application goes into production can cost as much as 200 times more than it would have during testing. Proper testing also helps increase the range of devices, carriers and operating systems the application will run on, increasing its revenue and profit potential. Cognizant Testing Services, the world's largest dedicated testing service provider, has worked with leading mobile application developers and carriers in vertical markets ranging from communications to

financial services, travel, life sciences and media services to assure the highest levels of usability, performance and security. Based on this experience, it recommends that testers use emulators where appropriate, perform as much testing as early as possible in the development cycle, and adapt their test scripts to reflect the unique requirements of the mobile environment.

Emulators: Use With Care

Ideally, all mobile application testing would be done on the target mobile device so that every possible interaction among its hardware and software elements, as well as with the carrier's network, could be tested in the most accurate and reliable environment.

However, acquiring every possible target device and performing manual testing on it is too complex, costly and time-consuming to be feasible during every stage of testing. Device emulators – software that simulates the performance and behavior of the physical device – are far easier to obtain and less expensive than samples of the physical devices. While they can be less accurate test platforms than the actual hardware, they can be a cost-effective complement to testing on the physical device when used appropriately.

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Cognizant Testing Services recommends using such emulators during the initial phases of development and testing, to validate the function of various units of source code as they are completed.

Early testing of these small subsets of code makes it possible to find and correct problems early in the development cycle and thus reduce the time and cost of rewriting code. Cognizant recommends testing on the more accurate, but more expensive, physical devices for user acceptance testing of the complete application, and for testing features that interact directly with the hardware and the carrier's network, since these are where otherwise hidden problems are most likely to be found.

Emulators for a wide range of popular handsets are available on the Web, ranging from low-cost freeware to more expensive commercial applications that offer higher levels of formal support. Emulators can be used to test Web applications using the software development kit for a browser, or by packaging the application as a .jar or .sis (platform specific) file, installing the application on the emulated device and testing the application.

Web servers and Web pages meant to be accessed from mobile Web browsers can be tested using Firefox browser plug-ins, by loading information about the handset such as user agent details, headers and handset/vendor ID into an .xml file. Using XHTML and WML add-ons to the browser, testers can verify if the Web pages display correctly on the device browsers.

Test Processes

Many organizations building mobile application are highly attuned to the latest changes in mobile technology, how those changes determine which features are important to users and to the need to get applications to market quickly. However, they are often not as aware of the need for proper development and test processes. This means that undetected performance, stability or security issues can cripple their applications, no matter how appealing they may be to consumers.

In such organizations, the test group reports to the development group, robbing it of the independence it needs to insist on the proper amount and type of testing. Cognizant recommends such organizations create an independent test unit, or use a third-party testing organization that can deliver an unbiased assessment of the application.

Because of the emphasis on time-to-market, many mobile applications are developed using RAD (rapid application development) in which multiple versions of the software are quickly developed, assessed by end users, and tweaked accordingly. This rapid-fire cycle of coding and re-coding makes it almost impossible to assess how each change affects the application's performance, stability or security.

For this reason, Cognizant recommends using, wherever possible, a "V" or modified V-form methodology in which testing is done as each unit of code is developed, thereby resolving problems at the unit level before those units are combined into larger application modules and evaluated by users.

Cognizant Testing Services recommends use of the V-model for all core application components such as the phonebook, messaging and Bluetooth stacks and the media player, and using a V-model for mobile business applications to reflect the more iterative development model used for them. RAD should be used only for prototypes, since adequate testing is virtually impossible using this model.

Test Scripts

Finally, Cognizant Testing Services has found that developing mobile applications requires changes in how organizations build accurate scripts for user interface, functional and standards compliance testing.

User interface test scripts should be based on specification requirements provided by the clients, such as descriptions of how each page or screen should look on each target platform, definitions of how various UI components are used on various devices, descriptions of device-specific interactions such as the use of soft keys or labels, and of any required keypad actions that are not obvious.

Functional test scripts should be developed using system or specification requirements provided by the client. These should include elements such as input and output parameters, menu selection criteria, and descriptions of other operations unique to the mobile environment such as the receipt of incoming calls, call termination, receipt of SMS messages and various charging scenarios.

In building such scripts, testers should also be aware of certification standards developed by not only individual handset vendors or carriers, but industry groups. Some of the most important of these have been developed by the Open Mobile Alliance (OMA), to which all major handset vendors comply, covering areas including digital rights management, content provisioning and device management.

The OMA publicizes specifications for testing for each of its major standards areas, which testers can use to create appropriate test scripts.

Carriers may also develop their own test scripts to determine if applications are browsable and downloadable from their on-line application stores, and are installable on various mobile devices. This type of testing, which is widely used in Europe, is called Operator Acceptance Testing.

Summary

The mobile application market holds massive promise, but even applications that address a popular market niche will fail if they do not download and install properly on users' mobile devices or fail to work properly due to configuration issues. No matter how "cool" or timely an application, it will not succeed if it does not deliver a satisfactory or even delightful user experience. On the other hand, devices and applications that exceed users' expectations for ease of use, such as the Apple iPhone, can deliver extraordinary market success.

Despite the time pressures in the mobile development market, proper testing is vital to increasing long-term business success and differentiating an application in a highly competitive and crowded market. Such testing requires taking into accounts the complexity of the mobile application environment and the needs of end users, as well as careful use of the specialized tools and processes needed to cope with this unique application environment.

About Cognizant Testing Services

Cognizant's Testing practice is an independent business unit within Cognizant, focused on verification and validation of applications. Since its formation in 2001, it has grown to include more than 9,000 employees, testing code written by Cognizant as well as by third parties or clients. This testing practice is organized by areas of industry specialization such as financial services, insurance, healthcare, manufacturing/retail, and telecommunication, media and entertainment. This alignment helps leverage Cognizant's domain expertise and provide domain-aligned testing, a critical success factor for independent software testing.

About Cognizant

Cognizant (NASDAQ: CTSH) is a leading provider of information technology, consulting, and business process outsourcing services. Cognizant's single-minded passion is to dedicate our global technology and innovation know-how, our industry expertise and worldwide resources to working together with clients to make their businesses stronger. With over 50 global delivery centers and more than 64,000 employees as of June 30, 2009, we combine a unique onsite/offshore delivery model infused by a distinct culture of customer satisfaction. A member of the NASDAQ-100 Index and S&P 500 Index, Cognizant is a Forbes Global 2000 company and a member of the Fortune 1000 and is ranked among the top information technology companies in BusinessWeek's Hot Growth and Top 50 Performers listings.

Notes:
For more information on how to drive your business results with Cognizant, contact us at inquiry@cognizant.com or visit our website at: www.cognizant.com.

Cognizant | Customer Solutions Practice
Passion for building stronger businesses

World Headquarters
500 Frank W. Burr Blvd.
Teaneck, NJ 07666 USA
Phone: +1 201 801 0233
Fax: +1 201 801 0243
Toll Free: +1 888 937 3277
Email: inquiry@cognizant.com

European Headquarters
Haymarket House
28-29 Haymarket
London SW1Y 4SP UK
Phone: +44 (0) 20 7321 4888
Fax: +44 (0) 20 7321 4890
Email: infouk@cognizant.com

India Operations Headquarters
#5/535, Old Mahabalipuram Road
Okkiyam Pettai, Thoraipakkam
Chennai, 600 096 India
Phone: +91 (0) 44 4209 6000
Fax: +91 (0) 44 4209 6060
Email: inquiryindia@cognizant.com