This whitepaper outlines the critical areas of testing needed to certify mobile enterprise applications.

Best practices from UST Global’s Mobile Testing Center of Excellence are outlined in this whitepaper.
Table of Contents

Executive Summary .................................................................................................................................... 2
Challenges ................................................................................................................................................... 3
UST Solution ................................................................................................................................................ 5
Implementation ............................................................................................................................................ 8
Summary .................................................................................................................................................... 10
About UST Global ..................................................................................................................................... 11
Executive Summary

Mobile application usage is exploding across the world today. All told, there are several hundred thousand mobile applications available to consumers today across platforms such as Android, RIM, Windows Mobile, and Apple’s iPhone. Many of these applications are becoming centers of efficiency as well as new and sustainable profit for software delivery organizations. Many consumers of web applications via desktops and laptops now expect, at minimum, a basic continuance of the same web services while away from their computers and on their mobile devices. Companies not providing such services are clearly losing market share and profits to competitors who are.

In fact, the mobile market intelligence company, ABI Research, anticipates worldwide enterprise mobile data revenues will reach $133 billion by 2014. Clearly the pressure to get high quality mobile offerings tested, certified, and launched on time has never been greater – and will continue to skyrocket. Increasingly, software delivery organizations can no longer holistically serve their customer base without a viable mobile offering, as more and more consumers demand robust mobile application options for both business and personal use.

While mobile applications are rapidly becoming critical pieces of a profitable corporate software delivery offering, new and complicated challenges to the software delivery model are also taking center stage.
Challenges

Mobile application users tend to be savvy and, as such, have high expectations of quality for applications they install on their devices. Applications are expected to be responsive, stable, and secure. They want simple to use interfaces and they expect 100% uptime 24x7. Lastly, they expect application functionality to be problem-free, whether they are on their personal iPhone or Android phone, their work Blackberry, or their personal Windows Mobile, Linux based, or Apple tablet device.

One of the most difficult challenges facing testing teams is the very large, and constantly growing, variation of mobile devices along with their ever changing configurations. The number of mobile device variations in the marketplace is quite staggering. Dozens of new mobile devices, such as Smart Phones, are being releases monthly by device manufacturers, many with incremental operating system features and enhancements, which are further adding to the variation of configurations of these devices. Add to that, the ever increasing variety of tablet devices; the impact of new mobile application development trends, such as the increasing adoption of HTML 5 as a mobile browser platform; various carrier network enhancements, such as 3G to 4G conversion which will rapidly expand over the next several years, and you can begin to clearly see how the testing challenges are rapidly becoming overwhelming for many mobile software development organizations.

This set of challenges is unique to the mobile testing world, and are quite different from traditional desktop or web delivery testing models. While in the traditional software development delivery world, you must account for and test variations of hardware and operating system compatibility with product releases, it is no where nearly as complicated as it is in the mobile world.

Today, the number of mobile devices, mobile operating systems, firmware updates, and other possible customizations create an impossibly large set of testing permutations. With all of these testing permutations, the cost and complexity of managing QA and testing in the mobile world is a very large challenge for many organizations.

UST Global’s® Mobile Testing Center of Excellence is a thought leader in this area. Our team can provide your organization with a mobile testing strategy to navigate all of these testing challenges in a cost effective way.
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<tr>
<th>Unique Challenges of Mobile Testing</th>
<th>UST Global’s Test Center of Excellence Best Practice</th>
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<tr>
<td>The numbers of mobile devices are increasing by the day. Device and software/environment configurations are numerous</td>
<td>Test early &amp; often to catch any device specific defects to minimize risk to the mobile SDLC schedule.</td>
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<td>Firmware updates are numerous and can affect application functionality. A testing strategy for these updates must be in place.</td>
<td>Always retest your applications after a major or minor firmware upgrade occurs in the field. Also as a rule, test builds after all mobile application development SDK updates</td>
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<td>While adding new devices can have minimal impact to the mobile development schedule, the impact to the QA schedule can be significant as a result of this</td>
<td>The QA team needs to be fully involved in all scope changes to the project to properly assess schedule impact for mobile device testing</td>
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<td>Mobile device configuration management is a significant task that the QA team must plan for during the test strategy definition phase. Devices come in various form-factors with a variety of screen types, platform versions, and underlying hardware. In addition, there are multitudes of input methods such as touch screens and device specific buttons. There are also other hardware elements that need to be accounted for, such as cameras.</td>
<td>The QA team needs to understand the target market for the application under test to properly plan for configuration management tasks that are critical to the success of the mobile application testing cycle.</td>
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UST Solution

**Emulation and Device Testing**
When it comes to testing mobile devices, there are two fundamental ways to approach the testing process. The first way is to use an emulator, which is a software application that allows you to reasonably simulate the behavior of a mobile application on a given mobile device configured in a certain way. While emulators are quite useful, they are not to be relied upon solely due to limitations in the emulation software. The second way is to use the actual devices you are targeting in the mobile marketplace. UST Global’s Mobile Testing Center of Excellence recommends a test strategy approach that includes actual mobile device testing, so as not to rely on emulators exclusively. This can be a daunting task (as well as an expensive task) as there are typically hundreds of active target market devices across the most popular mobile platforms (Apple, Blackberry, Windows Mobile, Android, etc.).

UST Global’s Mobile Testing Center of Excellence can help devise a targeted approach to managing the proper mix of both emulator and actual device testing. We can provide a service that seamlessly manages the testing of mobile applications on these devices through our partnerships with mobile device lab providers. This provides the best opportunity to test your enterprise mobile applications on the largest set of mobile devices possible. Our service includes access to hundreds of configurable mobile devices from all of the top device manufacturers. This thorough testing strategy provides the best possible certification process for mobile applications on target market devices.

<table>
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<th>Mobile Test Emulator Best Practices</th>
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<td>Emulators &amp; automated tools can speed up the testing process, but a risk based approach is necessary to prove actual application behavior on real-world devices. <strong>Best Practice:</strong> Emulators are important testing tools, but actual device testing must be balanced appropriately.</td>
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<tr>
<td>Many critical mobile device testing conditions are not available with emulators, such as peripheral activity, hardware access (SIM card), network latency, memory footprint/usage, etc. <strong>Best Practice:</strong> Emulator limitations must be understood prior to developing a mobile testing strategy, so appropriate testing procedures need to be scheduled on actual devices during the testing lifecycle.</td>
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Some device emulators (i.e. Android) are able to work with industry standard automated tools. In addition, some mobile development platforms have built-in tools for automating testing (i.e. Monkey on Android). **Best Practice: Develop a mobile testing automation strategy that takes advantage of the emulator UI, as well as any native testing tools, to perform automated acceptance tests. This is very helpful during regression cycles and for future releases.**

**Automated Mobile Functional Testing**

Automated Mobile Testing is a time-saving advantage allowing teams to speed up the overall testing process. This is accomplished by creating intelligent scripts that can be used to test the expected behavior of a mobile application across many different devices at the same time. Many recent advances in tools for mobile testing platforms allow teams to choose tools that work in conjunction with current desktop or web application automation tools currently on the market.

UST Global’s Mobile Testing Center of Excellence has the knowledge to help navigate the array of mobile automation testing options and select the right automation platform that will provide a clear ROI over a given timeframe.

Some important considerations for choosing a mobile automated testing tool are as follows:

- Look for a tool that provides integration with your current ALM tool – A single centralized test management platform will allow your testing team to provide visible test results easily using the existing platform. This strategy also reduces the team’s total cost of ownership by reusing existing tools, instead of adopting new ones.
- Look for a tool that can integrate into your current hardware test bed, or can integrate into a service access platform that uses actual handsets in live networks.
- Look for a tool that has an easy to use (device-agnostic) mobile scripting language. This will allow your team to build test cases that can be easily maintained, reused and ported to multiple mobile platforms.

**Performance Testing of Mobile Applications**

Mobile performance validation and load testing is another critically important part of a successful enterprise mobile platform delivery. Both native mobile applications as well as browser based mobile applications need a comprehensive performance certification process prior to being released to
production. Stressing mobile applications prior to production rollout to ensure your user’s experience is optimal must be carefully considered and planned as part of your overall mobile testing strategy.

While Mobile protocols for applications are well established, both for in-browser and out of browser applications, the tools available for performance validation and load testing require specialized knowledge. Some of the major performance validation tools on the market, which are used for non-mobile enterprise applications, can be leveraged for mobile efforts as well. However, you need to have skilled performance engineers who understand mobile protocols for browser-based as well as native mobile applications. In addition, these engineers must be expert in performance and load testing concepts and best practices.

UST Global’s Mobile Testing Center of Excellence has the expertise and experience to provide guidance in this area to help you meet optimal performance benchmarks for your mobile enterprise application rollout.
Implementation

Critical components of mobile application testing

A well planned mobile testing strategy needs to account for an end to end holistic approach that leverages the best practices of each testing phase to certify an excellent end user experience that will drive repeated mobile consumer usage, which will lead to furthering your enterprise brand.

UST Global’s Mobile Testing Center of Excellence strongly recommends the following components be included in your overall enterprise mobile testing strategy:

- Installation testing (over-the-air methods of installation need to be thoroughly verified)
- Test installations on devices with low resources and low memory
- Test the server or service under load, including stress testing (many users, simulated clients)
- Test the mobile device for security threats and vulnerabilities that could allow hacker’s to hijack your user’s data (such vulnerabilities are published in various security journals). Every mobile OS will have different vulnerabilities. For example, the Apple iOS vulnerabilities are different than Android’s, so different testing techniques will be needed
- Test the device security (passwords should be encrypted, and sensitive data should not be transmitted unencrypted)
- Simulate Network connectivity drops and disruptions, as well as the device being switched offline; these are critical state conditions that can affect application behavior greatly
- Usability testing needs to be done to ensure application behavior and usage is consistent across various devices with various screen sizes
- Interruptions from the operating system need to be handled properly (incoming messages, calls, and powering off)
- Internationalization – if the mobile application will be localized be sure to test in the most verbose language (i.e. German). You can expect strings, dates, times, etc. to be at risk in any localization testing scenario
- For devices that multi-task, system resource testing is critical to ensure resources are being released (memory leaks are not occurring)
- Test backup and restore services and sync features that synchronize user data
Tips and Tricks for mobile QA teams

The following are some useful tips from UST Global’s Mobile Testing Center of Excellence:

- Define a clear “Clean start state testing definition” for each test plan (a baseline definition for mobile devices; may include uninstall procedures, or factory resets)
- Simulate loss of network or phone coverage accurately by testing in a tunnel or placing the phone in a refrigerator and not just by manually shutting off the wifi connection
- Remember to test all entry points to the application
- Remember to test in different coverage areas and with different network speeds
- Use battery power. Don’t test with the device plugged in all of the time to simulate any edge conditions with a low battery
- It is essential to test all applications when the device has no signal (and in airplane mode, and such) to make sure functionality is not compromised
- It is critical to test functionality with peripheral activity (camera capture, headphones, SD Card insertion, location-based services)
Summary

Mobile Testing of Enterprise applications is a significant challenge for even the most experienced software development organizations. UST Global recommends partnering with a capable thought leader and partner in this area, to ensure your enterprise mobile platform offering serves the needs of your business and the needs of your consumers well.

As you can see from the various strategic and technical challenges with mobile testing that we have outlined in this whitepaper, UST Global’s Mobile Testing Center of Excellence is uniquely positioned to provide you with this level of expertise.
About UST Global

UST Global® (UST) is a leading provider of end-to-end IT services and solutions for Global 1000 companies. We use a client-centric Global Engagement Model that combines local, senior, on-site resources with the cost, scale, and quality advantages of off-shore operations.

In every business engagement, we seek the opportunity to build long-lasting, strategic relationships. This client-centric focus forms the basis for how we, as a company, operate and serve our clients. Commitment to long-term client success empowers every associate to provide value and flexibility beyond the contract.

About The Authors

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