MOBILE APPLICATION TESTING

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Abstract: Mobile app testing is the process of testing the applications developed for hand held devices for usability, functionality and performance issues. Mobile app testing is a little different when compared to the testing done for desktop applications as many things need to be considered like the user interface , hardware , platform connectivity issues and many more.

1.Introduction

Mobile app testing services are for companies and individuals who are involved in mobile application development. As there has been a drastic increase in the use of hand held devices, there has been an increase in the number of applications being created, in order to fulfil consumer demands. This has opened up a market for the software developers. You need to make sure that your developed app is mature enough to be released in the market and is void of any technical and usability issues, for which testing is extremely important.

Mobile app testing may be time consuming and expensive, but it is critical and ensures that the customers do not find any difficulty using the application. If the app developer fails at doing a good job at testing, it may lead the customers to do the testing which might cause them trouble as they do not have the same tools as the developer does.

A comprehensive mobile app testing strategy includes device and network infrastructure, optimized selection of the target devices and a combination of different tools to cover both the functional and non-functional aspects of the application is important to ensure that the application gets launched on time.

When is Application testing necessary?

Generally it is better to do the testing in the early stages of the development in order to avoid complicated issues in the later stages of the product development. Sometimes testing in the earlier stages might cost more, but may not give proper results, thus, it may be better to test one module at a time.

Following are the key elements that must be taken into consideration:

- **Target Selection**: create an optimal mix of simulator testing and physical device testing on different models
- **Test Automation:** Select a good automation tool, in order to maximize the use of resources in regression testing.
- **Network Environment**: Initially start by testing on a local Wi-Fi and then select a tool to simulate a cellular connectivity.
- **Types of Testing:** Consider different types of testing depending on the application and also the needs.

2. Mobile App Testing

Mobile apps either come pre installed or can be installed from the application providers. In the last decade or two has seen immense increase in the number of mobile devices and so there has been an increase in the number of applications as well.

2.1 Variety of mobile devices: Hand devices come with many variations and differences like different screen sizes , UI and different input methods and hardware

2.2 Different OS/Platforms: There are different OS in the market now like Android, IOS, BREW, Windows7.5, Mango. Every platform has its own challenges and ways to deal with.

2.3 Different network providers: There are many network providers present today. Few are CDMA, GSM and few are FOMA and TD-SCDMA. Every network provider has a unique infrastructure and therefore may limit the flow of information in their own way

2.4 Scripting: As devices vary so much in their hardware and UI, therefore, the code for the application must be written differently and may be a major problem if an app is being created for multiple platforms.

3. Types of Mobile App Testing

Mobile app testing is broadly divided into two main categories:

Hardware Testing: This includes testing of the physical components of the device like, screen, resolution, size, camera, Bluetooth, ports and many more. This is also known as Mobile Testing

Software or Application Testing: The actual app that will be installed and used on the mobile devices is tested for its functionality and usability. Even in this there are different kinds of apps that have to be tested in their own ways. This is known as "Mobile Application Testing". Types of such apps are:

- **Native apps**: These are created and used on mobiles or tablets.
- **Mobile web apps:** These are server side apps that are used to access the websites by connecting to the mobile or cellular network.
- **Hybrid apps:** These are a combination of native and mobile apps and the run on devices or offline and are designed or written using HTML5 and CSS.

3.1 Actual kinds of Mobile App Testing:

Usability Testing: This is to see if the app is easy to use and if the user interface is working according to the customers' expectations or not.

Services testing: Testing for the applications' behaviour both online and offline.

Compatibility testing: Testing to see how the application works on different platforms, how it looks on different screens and resolutions and how it responds to different user interfaces.

Interface testing: Testing the various components that the user interacts with in the app like menus, buttons, navigation tools and many more.

Performance testing: This is especially done for the apps that run online. Here testing is done by changing the connections from 2G to 3G and other networks as well, and the performance is evaluated in each network. Also , it sees how fast the app responds for both online and offline applications and accordingly the apps can be optimized.

Low Level Resource testing: This tests for the memory usage of the apps and the auto deletion of files and so on.

Operational testing: This testing is done to see how the app works if the battery goes down and sees how the data is recovered if the device gets switched off while using the application. Thus it looks for the backup plan for the app.

Security testing: Checks if the data set in the app is secure or not.

Interrupt testing: This sees how the apps reverts after an interrupt like phone calls, messages ,etc.

Installation testing: Many apps come predefined while some have to be downloaded from the provider, This testing checks if the installation process has any interrupts or problems in it.

Certification testing: In order to get the certificate of compliance, the app has to be tested against a set of guidelines. This testing is done to see how well the app abides by the required guidelines.

3.2 Scope of testing

White Box Testing: Tests the internal structures or the components of the app. The person testing the app should have an idea of the internal perspective of the app and also good knowledge of the source cide in order to design user test cases. This includes many techniques like Control flow testing, Data flow testing, Branch Testing and many more. Therefore, this looks into the logical errors in the of the code.

Black Box Testing: This examines the functionality of the app without looking into the internal structure of the application. It includes many things like, Use Case testing, Equivalence partitioning. This therefore, looks into the functionality errors.

4. Mobile App Testing Strategy

Even before testing, we need to have a testing strategy in order to meet the customers' requirement, specifications and to avoid negative feedback. Testing is an important step for quality assurance.

Fig 4.1 Mobile app testing strategy plan

4.1 Selecting target devices

The target devices used for testing must should balance the need to use a representative sample the expected device population with the need to optimize duration and cost during testing. The target devices used of testing need to represent the population of the devices that will be using the application.

4.2 Simulators vs Physical Devices

Testing the app on system simulators is useful in the early stages of the development, as it allows the test team to get used to the various features of the app.

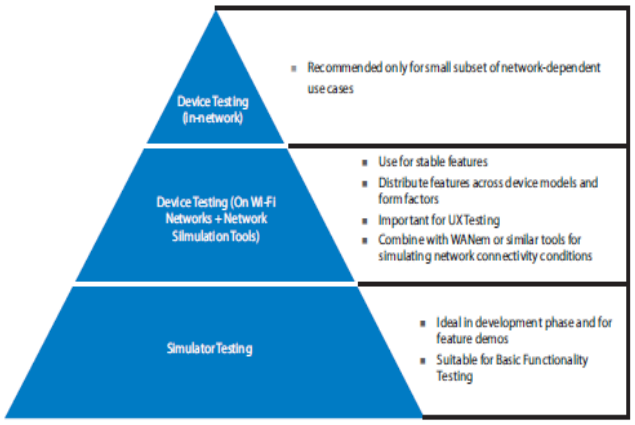

Fig 4.2: Conditions for testing on devices/simulators and different network connectivity options.

4.3 Device Model Selection:

Factors to be considered while selecting a device for testing:

OS Version: The device being selected must have the version which is available on most population of devices.

Form Factor: devices behave differently on smart-phones and tablets. So if the application is being developed for both tablets and mobiles, we need to test them separately and analyze the behaviour.

Display Density: The screen resolution and size effect the application user interface, therefore, the device used fir testing must include a mix of different display densities.

When it comes to IOS devices, selecting a test devices is easy because of lesser models available, where for Android we need to see the most popular device in the market at that particular time and then adjust the features of the app accordingly.

4.4 Connectivity options:

In order to test the apps that require internet to work , it's better to set up a Wifi and then test the app as it is easy and inexpensive when compared to the cellular devices that are very unpredictable when it comes to providing internet.On location testing of the application must also be considered and done for a few specific applications.

4.5 Manual vs Automated Testing

Automated testing provides us to do repeated testing over the same code or app and goves the results and verifies them to the expected end result. It is very helpful when it comes to regression testing, but the main drawback when it comes to automated testing is that it requires very high initial investment and sometimes the return on investment is quite poor. The ROI here depends on the test cases that are selected for testing the app, so in order to get high ROI], we need to properly select the test/use cases.

To get the maximum output from the automation, all the automatable test cases of the release need to be automated before the next release.

5. Mobile App Testing Tools:

There are certain tools to be used for testing the mobile applications. A proper tool is very important to carry out testing on the app without any interrupts or problems. Following table shows a few tools that can be used for testing.

Logo	License	Support Device	Scripting/ Language
Android SDK	Open Source	Android	JAVA
iOS Simulator	Open Source	Window or Mac iOS	Objective C
MonkeyTalk	Open Source	iPhone & Android etc.	HTML5 & JAVA
Cucumber	Open Source	Multi Platforms	Unit Test
TestPlant	Cost	iPhone & Android etc.	Test across mobile OS with a single script
	Open Source	Variety of platforms	C#
perfecto mobile	Cost	Multi Platforms	A single Script
experitest	Cost	Android, iPhone etc.	C#, Java, Perl & Python
keynote DeviceAnywhere	Cost	iPhone, Android etc.	JAVA & Objective C

Fig 5.1 Some Mobile app testing tools

5.1 Mobile App test tools landscape

Effective tools must be present in order to overcome the complexities of mobile application testing.

5.1.1 Remote Access Solution for Manual Testing

Before the advent of smart-phones, the applications had to be tested over a wide array of devices under a particular service or network provider. So, the providers

have provided the testers with a set of devices where the testing can be carried on, this is called remote access or device cloud. This device cloud was later extended to include today's smart-phones. Most of the devices today are predominantly either Android or IOS, therefore testing has to be done a upto 7 different IOS devices and upto 15 Android devices and testing can now a days be done on a WiFi network instead of a cellular network.

5.1.2 Automation tools

There are two major tools used for automation:

Object based tools: These tools take the various components on the application screen and map them to objects and manipulate them. This tool can be used irrespective of the size of the screen and also allows the code to be reused fro various versions of the app and then test them again.

Image-based and bitmap tools: These create automation tools by using the screen co-ordinates of the elements. It requires rooted devices and the code has to be re written again and again for every device with a different screen size and resolution.

Most of the automation tools today are either too expensive or have ineffective ROI

6. Mobile App Testing Cycle

Mobile apps are being upgraded frequently for one or more of the following reasons:

1. The mobile users need recent updates and bug fixes
2. The upgrades are done to take advantage of the newer versions of operating systems and platforms.

Every time an application is upgraded an additional testing cycle is required to assure that the application is compatible with the newer platform and operating system

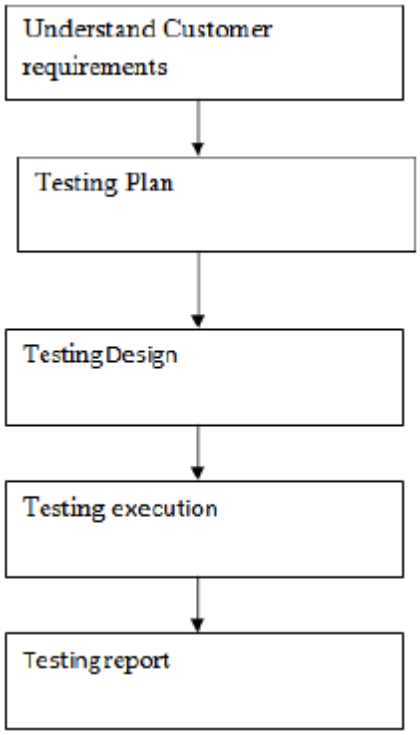

Fig 6.1 Mobile app testing cycle

Important things that need to be considered during the testing cycle are:

Test Environment: This includes selecting devices for testing. We need to make plans for DUTs(Device under test), that is, we e need to consider the fact that there will be frequent OS updates and that should not alter the behaviour of the app.

Application under testing: Depending on the needs of the organisation, they need to make a decision on whether to create web app, native or hybrid application. Any changes must go through Quality Assurance and test cases must be created for each approach.

Automation: Most of the tools used for testing are OS specific and cannot be reused for testing the app for multiple systems or OSs and many tools favour web based applications over others. Therefore proper tools must be selected in advance for testing the applications.

7. Challenges in Mobile App Testing

The current market is about the mobile devices and all, experts even predict that in the near time these mobile devices might take over desktop devices and PCs, but with every new thing comes its own set of challenges which become very difficult to tackle. Following are the few challenges faced:

7.1 Mobile App Testing is different

Mobile app testing is quite different from Desktop web applications. In case of web applications, they need to be tested on a single platform and the testing is done, but when it comes to mobile applications, there is one specific dormant platform to test, therefore we need up creating multiple versions of the app for different operating systems and also different versions of the same operating system. Thus, it is more complex and time consuming

For desktop systems, there is standardized hardware implementation, but for mobile devices the hardware changes from system to system and sometimes it changes for two different releases of the same device causing one of the main problems when it comes to mob app testing. The android gallery itself has 60 different device configurations with different screens resolutions and many more.

The mobile apps behave differently depending on the network availability, interrupts like notifications, calls ,etc which requires additional testing cycle to make sure that the app is acceptable in the real world scenarios.

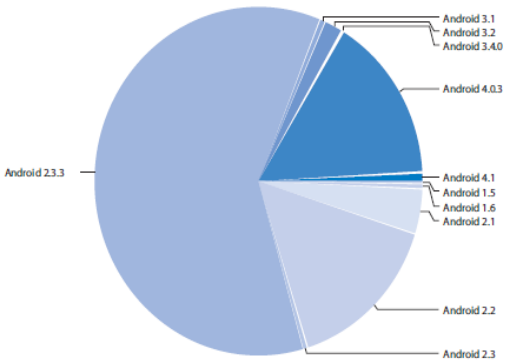

Fig 7.1.1 Android OS Version Fragmentation

All these different factors make mobile application testing complexity, time consuming and expensive.

7.2 Aspects of Testing Mobile App

In order to properly understand the complexity of testing mobile applications, we need to understand the various aspects of it.Some of these aspects may be general to any software testing while others are more specific to mobile app testing.

The kind of testing that is needed for an application depends on many factors like:

- The target customers
- The kind of application being developed
- Distribution channel(the store that'll be selling the app)

Aspect	Areas / Types of testing
Functionality	User Interaction Testing Transaction testing
Performance	UI responsiveness Transaction completion time(s) Peak load performance Longevity
Network	Network type (Wi-Fi, 2G, 3G, 4G) Impact of Connectivity Issues
Security	Data Retention on device Transmission Security
Compatibility	Mobile Platform Compatibility (e.g. iOS 6, iOS 5.1.1, iOS 5.1.1) Device Model Compatibility Backward compatibility (with previous app version)
Conformance	Marketplace guidelines compliance (e.g. Apple App Store policies) Enterprise policy compliance (e.g. prohibited content)
Usability	User Experience
Installation and Provisioning	Installation process Un-installation process User provisioning and de-provisioning

Table 7.2.1 Aspects and kind of testing

8. Future of Mobile App Testing

There are lot of new things that have come up in the recent times like:

- Use of HTML5
- Change of the definition of mobility: Mobility is just not restricted to smart phone and tablets, but has also extended to all those devices that can be connected via the internet.
- Increased expectations for product quality
- Newer technologies
- Social and e-commerce: Many apps have come up that help the customers to make online payments , shop online and many more.

Increased application complexity, many integration channels and higher user experience expectations have increased the pressure over those who provide for the mobile app testing. Earlier testing was done on a set of test devices present with the team, but that's not the case anymore as having all such test devices is difficult because of the increase in the number of models of smart-phones and tablets and versions of operating systems , so now mobile testing has moved onto cloud where the provider gives access to a set of devices present on his cloud, this is called the test cloud.

8.1 Mobile app testing and cloud

A cloud based test environment provides the QA department with a whole array of choices from different devices to different operating systems as well as different versions of the operating system and languages in which the scripting has been done. It also allows scripting and IDE integration and worldwide Quality Assurance

Advantages of cloud based testing:

Cloud based testing allows the test team to concentrate on the actual testing and the application rather than wasting their time in maintaining an extensive test bed.

Following are the few advantages provided by cloud based testing:

- The applications run in a secure environment.
- There are a wide variety of languages and tools to choose from.
- Automates test results are collected in logs.
- Parallel testing saves time.
- All testing modes are available.

There are many tools available that provide cloud based testing environment like xamarin, Keynote device Anywhere lab, Sauce Labs Automated Mobile Testing and many more.

10. Conclusion

Even though mobile app testing has its own set of challenges, the right choice of target devices, connectivity options and

tools that maximize automation ensure efficient , effective and cost free testing.

Selecting the target devices properly and mixing up the simulators can help us in giving maximum test coverage preventing us from testing each and every component of the app. Using Wifi network in combination with the network simulation tools provides a much better platform to test the apps when compared to the cellular network. Proper and efficient automation reduces the long term testing costs and all the factors mentioned earlier in the paper must be taken into consideration while selecting an automation tool.

We can design and develop better quality applications by testing all the aspects of the app. These trends show how different mobile apps are when compared ot he web and desktop applications and prove that different testing methodologies and strategies need to be implemented, which takes the current scenario and the mobile world into consideration and adjustments need to be made to the conventional testing methods and strategies.

11. References

http://www.optimusinfo.com/cloud-based-mobile-application-testing-tools/