

COMPARATIVE STUDY AND ANALYSIS OF VARIOUS MOBILE BUGS

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Abstract

Smartphones have essentially become a part of life and users are becoming highly dependent on mobile applications for day to day needs. This paper argues that a lot of problems happening in millions of smartphones handsets that have led to significant user frustrations, are due to bugs upcoming in mobile applications. We take a first look at this emerging important technical challenge faced due to the smartphones bugs, which is relatively an error in the system that causes an unexpected amount of issues in the system. We have first presented a brief idea of the kinds of bugs based on study over more than 500 responses from market survey conducted across all telecom circles in India. This research shows the highly diverse nature of smartphone bugs in various smartphones across all categories of equipment manufacturers.

Keywords: Smartphones, Bugs, Energy Bugs, Hardware Bugs, Software Bugs

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Introduction

Despite the high market penetration of smartphones and exponential growth of their apps market, smartphones have remained the susceptible of various software, hardware and energy bugs. As matter of fact, these bugs have become so prominent that already, they have led to frustration among users by abnormal behavior of mobile and loss of personal data of user. Errors that happen in programming, complexity in framework designing and applications interfacing and redundant scripting leads to software bugs. Network bugs are triggered due to remote server crash and drop in wireless signal strength. Energy bugs are caused, when applications provide their intended services normally, but consume large amount of energy depicting unexpected behavior in energy consumption. This results in mobile devices running out of battery much sooner than expected time, requiring frequent recharging or resulting in unplanned device battery outage.

This paper takes a first look at bugs on smartphones and calls for the research community to expend research effort to tackle the associated technical challenges in treating them. We first present a taxonomy of the kinds of bugs based on mining over more than 500 responses from market survey conducted across all telecom circles in India. The taxonomy illustrates the diverse nature of possible bugs on modern smartphones in terms of their symptoms and causes.

Overview of different Mobile Operating System

Android

Android OS is a platform based on Linux. It was a collaborative effort by Open Handset Alliance and Google. Basically they form a union of hardware, software and telecommunications companies. It is important to note that there are more than 30 organizations which were involved in the OHA, comprising of Qualcomm, Broadcom, Intel, HTC, Samsung, Sprint, Motorola, Texas Instruments and Japanese wireless carriers NTT Docomo and KDDI.

USER INTERFACE: The user interface by default is based on a phenomenon which is direct manipulation, which is activated using touch sensitive inputs, that corresponds to various actions

which are performed in real world, like swiping, tapping and pinching to manipulate the objects which can be seen on the screen along with the virtual keyboard.

APPLICATIONS: Software Development Kit by Android is used for writing the extension of the functionality of devices. Java programming language has full-fledged access to Android Application Programming Interfaces.

HARDWARE: ARM architecture is the main architecture on which it is based. In the Android versions which were released later, x86 and MIPS architectures also were supported.

In November 2007, Android beta version was released. Android 1.0 which is known as the first commercial version of Android came in the month of September in the year 2008. Android 5.0 is the recently updated version of Android which is named "Lollipop, released on 3rd November, 2014. The names and the corresponding versions of Android are listed below:

Name	Version
Cupcake	1.5
Donut	1.6
Eclair	2.0-2.1
Froyo	2.2-2.2.3
Gingerbread	2.3-2.3.7
Honeycomb	3.0-3.2.6
Ice cream Sandwich	4.0-4.0.4
Jelly Bean	4.1-4.3.1
Kit Kat	4.4-4.4.4
Lollipop	5.0-5.1.1
Marshmallow	Developer preview 3

Table 1: Showing various Android versions

iOS

iOS is the as the iPhones and iPads. MacintoshOS X is the basis for the design of iOS used with Apple's multi-touch device. Input is supported through direct manipulation. There are various input gestures such as pinching, tapping and swiping to which it responds.

There are various other iOS features which include:

- Mobile browser- Safari
- Searching through files, emails and applications simultaneously
- Google Maps navigation services
- Own exclusive cloud service (icloud) compatibility
- Media player integrated within

Windows OS

Microsoft Corporations had developed Windows OS for PCs. It became leader in the market after IBM in PC Manufacturing

MS-DOS or Microsoft Disk Operating System was subsequently super-ceded by the first version of Windows. Windows Mobile was a family of mobile operating systems developed by Microsoft for smartphones and Pocket PCs.

Its origins dated back to Windows CE in 1996, though Windows Mobile which was launched as PocketPC in 2000 was renamed "Windows Mobile" in 2003 and their prime focus was on business consumers. As it is facing tough competition from its rivals such as iOS, and Android, Windows Mobile has been deprecated after remaining popular in 2007. Windows Phone is not in compliance with devices and software by Windows.

Windows Mobile faces a tough challenge to survive in the mobile OS market from Android, iOS, Symbian and various others. It started with the release of Personal Digital Assistant for the Pocket PC in the year 2000. Crossbow (6th version), Ozone and Magento (5th version) were later released.

Symbian OS

Symbian Limited has developed its OS which is broadly used by Nokia having S60 interface and Sony Ericsson having UIQ interface. Along with this, the OS is also used by a number of Japanese handset manufacturers for export. With Nokia's acquisition of Symbian, the Symbian OS is now going to be an open source product offered by the newly formed Symbian Foundation. It is a closed-source OS and computing platform designed primarily for smartphones.

Currently, Symbian is an open-source platform. Symbian was used by many pioneer mobile phone brands, like Samsung, Motorola, Sony Ericsson, and above all by Nokia. It was the most popular smartphone OS on a worldwide average until the end of 2010, when it was overtaken by Android.

Nature of Bugs

An error or fault triggered in a software program that results in an unexpected abrupt or denial of service is called as software bug. Most of the bugs are generated due to manual errors in design, coding or architecture and very less are generated by compilers producing incorrect code. A program containing logical errors creates bugs, and these bugs interfere in overall application functionality. Bug reports provides a detailed description about bugs in a program. These bugs are often treated with different names in organizations as bug, issue and incident with respect to severity and its possible impact.

Technology convergence is increasing dependence of telecom sector more on IT products or integrated solutions, but solutions feasibility has not been taken care by vendors which results in network outage sometimes. Issues in software configurations, hardware applications also results in network problems and that gives rise to network bugs.

Battery life has emerged as the major concern for handset manufacturers. Some process keep running in operating system background which do not stop even after shutting down the applications. This is due to some bugs which keeps background processes running, such kind of bugs are termed as energy bugs. These energy bugs are responsible for reduced battery life of smartphone handsets. Power model is different for all platforms and hence energy bugs are different for Android, Windows and iOS.

Research Method

To gain understanding of bugs affecting smartphone users, we have crawled various internet forums discussing smartphone problems and bug reports, and identified a list of questions to

check performance of smartphones among different handset users. This analysis is done to extract unchecked reported bugs and find the root cause of the problem.

We have conducted a market survey in collaboration with QuestionPro, an independent research firm, to field confidential survey responses. We have collected user personal information, handset information, telecom service provider information and responses regarding behavior of their smartphones. We have collected around 500 responses from market survey conducted across all telecom circles in India.

We have categorized bugs in the following manner in order to develop an understanding of different forms of bugs.

Forms of bugs

- 1) Hardware bugs
- 2) Software bugs
- 3) Energy bugs
- 4) Network & security bugs
- 5) Performance & compatibility bugs

Hardware bugs:

- 1) Touchscreen problem-How user will rate the touchscreen of mobile handset.
- 2) Sound problem-How much user is satisfied with sound quality of handset.
- 3) Motion detector- How much user is satisfied with the motion sensor in handset.
- 4) Voice recognizer-How ease user feel in interaction with the voice recognizer.
- 5) Shutdown and restart-How often mobile get automatic shutdown and restart.
- 6) Showing uncharged-Have user ever found battery fully charged but mobile getting dead.

Software bugs:

- 1) Hang-How frequent applications get hang on.
- 2) Software crash-How frequent user get software crash report sending alert on your screen.
- 3) Navigation-Does user face problem in navigation in mobile.
- 4) Auto log out-Do applications get auto log out in case of update.

Energy bugs:

- 1) Battery drain-How long battery survive on full charge.
- 2) Mobile get warm-Does mobile get heat up during charging.
- 3) High charging time-How long does it take to mobile handset fully charge.

Network bugs:

- 1) Out of coverage-How often mobile get out of coverage.
- 2) Host not resolved-Does user face host not resolved problem during network connection
- 3) Synchronization issues-Does user face account synchronization issues during network reconnection
- 4) Wifi not accessible-Does mobile becomes inaccessible sometimes even on remaining wifi network.
- 5) File sharing compatibility-Does user face problem in sharing files through short range network connectivity like Bluetooth.

Operating System bugs:

- 1) Slowed down-Does OS get slow down after installing applications
- 2) Apps not compatible after upgrade –Do mobile applications turns incompatible after software package upgrade
- 3) Auto switching calls-Does user face problem during call switching.
- 4) Cached process not responding-Have user ever found some cached processes not responding.

We have collected response from different questions in terms of qualitative measures for user experience and technical functionalities. User Experience options are Highly satisfied, Satisfied, Unsatisfied, Highly Unsatisfied and Technical Functionalities options are Very often, Often, Rare, Very rare

Analysis of Bugs in different Mobile OS

Google Android

The highest number of mobile handsets in Indian market are of Android OS. Google Android is a popular mobile platform, hence the reliability of Android applications is becoming increasingly important. In this paper, we present an approach for identifying the symptoms of bugs that are hampering the processing of mobile handsets. As per our survey, 83.33% are Android users and 65.95% are not satisfied with performance of operating system and it slows down after installing more apps. 23.40% faced issues in compatibility in installed applications after OS software package upgrade. 31.91% of android users have faced issues in deleting files after uninstalling the apps.

Windows OS:

We have witnessed a market share of 6.67% of Windows in our market survey. Windows OS is the product of Microsoft Corporation which is mostly used in Nokia handsets. 25% of Windows users have complained about slowness in operating system after installing users. 25% users have also faced issues in software upgrade package and files not getting deleted after installation.

Apple iOS:

Apple iOS having least market share of 5% in Indian market, have received a good response in terms of operating system. Customers have not faced much issues in processing of operating system.

Analysis of Bugs in different Mobile handset

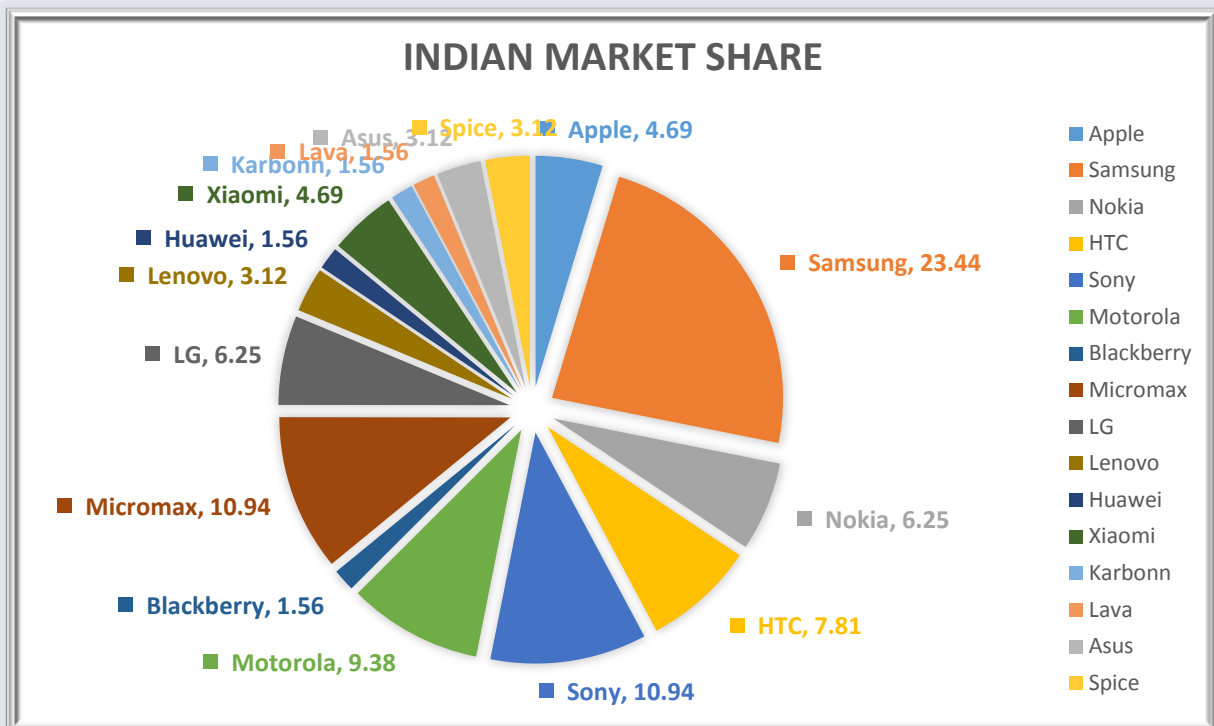


Figure 1: Showing market share of various handset vendors

Samsung

In this market survey, Samsung has emerged as the market leader with 22.22% share in Indian market. 64.29% of users have usage period of 1-3 years and 14.29% of users have 0-1 years of usage. Android has a share of 92.31% and BADA has a share of 7.69%. Share of users as per handset price chart is depicted in the bar graph. 22.43% users face problem in touchscreen of Samsung handsets, while 35% users have not found voice recognition system much user friendly. 28.58% users have faced battery issues and 42.86% users have reported automatic shutdown of handset.

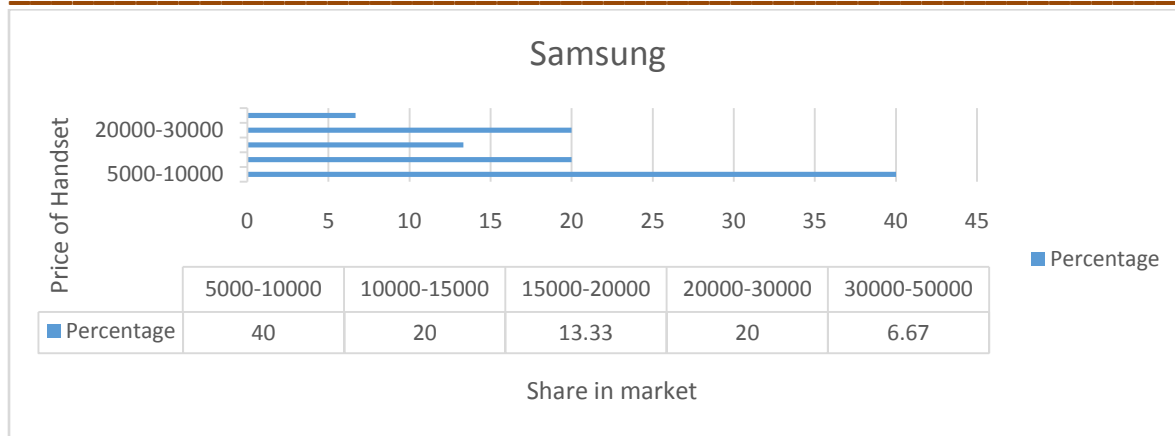


Figure 2: Showing share of Samsung mobile handsets according to price of handset

Micromax:

Micromax has become the leading domestic brand with 10.94% share in Indian market. 57.14% of users have usage period of 1-3 years and 42.86% of users have 0-1 years of usage. 28.58% users face problem in touchscreen of Micromax which is a major concern for smartphone category, and 28.58% of users have also found issues in voice recognition system. 71.43% of users have found 4-8 hours of battery survival after full charge in a day and 42.86% users have reported slowing down of handset performance. 14.29% have reported difficulty in sharing files with peer devices through Bluetooth or other file sharing options, which is better than other competitors.

Sony

Sony has faced a decline in market share in recent months and currently has managed to secure a 10.94% of market share in Indian market. Still Sony has 67.66% of users have usage period of 0-1 years and 31.86% of users have 0-3 years of usage. 96.48% of users have shown high satisfaction with touchscreen of handsets but 23% are not satisfied with motion sensing technology in Sony handsets. 25% users have not found voice recognition system much user friendly. 24% users have found unusual phenomenon of mobile fully charged but mobile getting

dead.32.14% of users have reported of handset getting hang issue and 16.67% users have reported difficulty in sharing files with peer devices through Bluetooth or other file sharing options.

Motorola

Motorola has emerged as a fastest growing player with a market share of 9.38% in Indian mobile handset market.66.67% of users have purchased Motorola handsets within recent one year.99% users are satisfied with touchscreen experience of Motorola handsets, while 75.56% users are satisfied with voice recognition system.26% users have reported battery issues lasting only 4-8 hours in a day after full charge. Around 12% users have reported automatic shutdown of handset and none of user has found difficulty in sharing files with peer devices through Bluetooth or other file sharing options.

Nokia

With the launch of Microsoft led Windows phone series, Nokia has captured a fair market share of 6.25% in Indian smartphone handset market. Nokia carry an equal 50% share among 0-1 years and 1-3 years of usage. There is about 50% dissatisfaction among users in touchscreen of mobile and 22% dissatisfaction in motion sensing technology.68.58% users have faced battery issues and 41.36% users have reported automatic shutdown of handset.37% of users have reported of handset getting hang issue and 26.43% have reported difficulty in sharing files with peer devices through Bluetooth or other file sharing options.

HTC

HTC has covered a significant market share of 7.81% in Indian smartphone handset market. There is close to 80% satisfaction among users about sensitivity and touchscreen.58.38% users have faced battery issues and 27.86% users have reported automatic shutdown of handset.59% of users have reported of handset getting hang issue and 40.23% have reported difficulty in sharing files with peer devices through Bluetooth or other file sharing options.

LG

LG also has covered a good share in Indian mobile handset market with a market share of 6.25%. There is a great experience nearly 100% among LG users about touchscreen and sensitivity. 25.34% users are having battery issues and 11.37% have reported difficulty in sharing files with peer devices through Bluetooth or other file sharing options.

Conclusion

Our work is a step toward the analysis of mobile bugs and their cause. We have presented metrics and dashboard to explain the demography of mobile bugs. We have done a market survey to understand the nature and kind of bugs that are predominantly affecting the processing of mobile bugs. Most of the bugs are generated due to misconfiguration of code, improper control flow and bad hardware interfacing with application programming interfaces (APIs). Mobile networks are becoming more software dependent and there is less interoperability among different vendors resulting loss in voice and data services. Multiple processes stuck in deadlock condition due to poor programming giving rise to unnecessary energy drain problems. Our study also highlights the frequency of bugs that are occurring in a particular manufacturer handset and users reporting the level of impact of bugs.

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