

Comparative study of tools for cross-platform mobile application development

Michiel Staessen

Thesis voorgedragen tot het behalen
van de graad van Master of Science
in de ingenieurswetenschappen:
computerwetenschappen,
hoofdspecialisatie Software
engineering

Promotor:

prof. dr. ir. Erik Duval

Begeleider:

ir. Gonzalo Parra

© Copyright KU Leuven

Without written permission of the thesis supervisor and the author it is forbidden to reproduce or adapt in any form or by any means any part of this publication. Requests for obtaining the right to reproduce or utilize parts of this publication should be addressed to the Departement Computerwetenschappen, Celestijnenlaan 200A bus 2402, B-3001 Heverlee, +32-16-327700 or by email info@cs.kuleuven.be.

A written permission of the thesis supervisor is also required to use the methods, products, schematics and programs described in this work for industrial or commercial use, and for submitting this publication in scientific contests.

Zonder voorafgaande schriftelijke toestemming van zowel de promotor als de auteur is overnemen, kopiëren, gebruiken of realiseren van deze uitgave of gedeelten ervan verboden. Voor aanvragen tot of informatie i.v.m. het overnemen en/of gebruik en/of realisatie van gedeelten uit deze publicatie, wend u tot het Departement Computerwetenschappen, Celestijnenlaan 200A bus 2402, B-3001 Heverlee, +32-16-327700 of via e-mail info@cs.kuleuven.be.

Voorafgaande schriftelijke toestemming van de promotor is eveneens vereist voor het aanwenden van de in deze masterproef beschreven (originele) methoden, producten, schakelingen en programma's voor industrieel of commercieel nut en voor de inzending van deze publicatie ter deelname aan wetenschappelijke prijzen of wedstrijden.



Preface

I would like to thank everybody who kept me busy the last year, especially my promotor and my assistants. I would also like to thank the jury for reading the text. My sincere gratitude also goes to my wife and the rest of my family.

Michiel Staessen



Contents

Preface	i
Abstract	iii
1 Introduction	1
2 Literature Study	2
2.1 The mobile device landscape	2
2.2 The problem of fragmentation	2
2.3 Strategies for cross platform development	4
<i>Native App</i> 5, <i>Web App</i> 6, <i>Hybrid App</i> 6, <i>Interpreted App</i> 7, <i>Cross</i>	
<i>Compiling</i> 7, <i>Summary</i> 7	
2.4 Reflection	7
2.5 Conclusion	7
Bibliography	9



Abstract

The abstract environment contains a more extensive overview of the work. But it should be limited to one page.

Chapter

1

Introduction

TODO: The first chapter contains a general introduction to the work. The goals are defined and the modus operandi is explained.

The mobile industry is without a doubt one of the most vibrant industries at the moment. Not only because mobile device sales are growing rapidly but also because of the highly competitive nature of this market. This has led to fragmentation.

This chapter will sketch the landscape of mobile devices, explain the problem of fragmentation and a number of suggested solutions to cope with this problem.

2.1 The mobile device landscape

In the last couple of years, smartphone sales have gone up quickly. Smartphones are becoming ubiquitous and in some regions, like the United States, smartphone penetration has already reached more than 50% [21]. According to quarterly studies by Gartner, smartphone penetration remained stable before the iPhone 3G and Android came along (see Figure 2.1).

But more importantly, one can conclude that there is not one major platform. Projections by the IDC show that in 2016, there will be at least three major platforms covering 90% of the worldwide smartphone market [18].

A similar scenario is playing in the tablet industry. According to other studies by both Gartner [11, 17] and IDC [19], tablets will continue to gain popularity and sales will be mainly driven by iPads and Android tablets (see Figure 2.3).

Even though both companies do not agree on which platform will be the biggest by 2016, they both predict there will be at least three major platforms; iOS, Android and Windows.

2.2 The problem of fragmentation

The competition among mobile device manufacturers has led to fragmentation on many levels. For consumers, fragmentation is usually a good thing. The more different devices

2.2. The problem of fragmentation

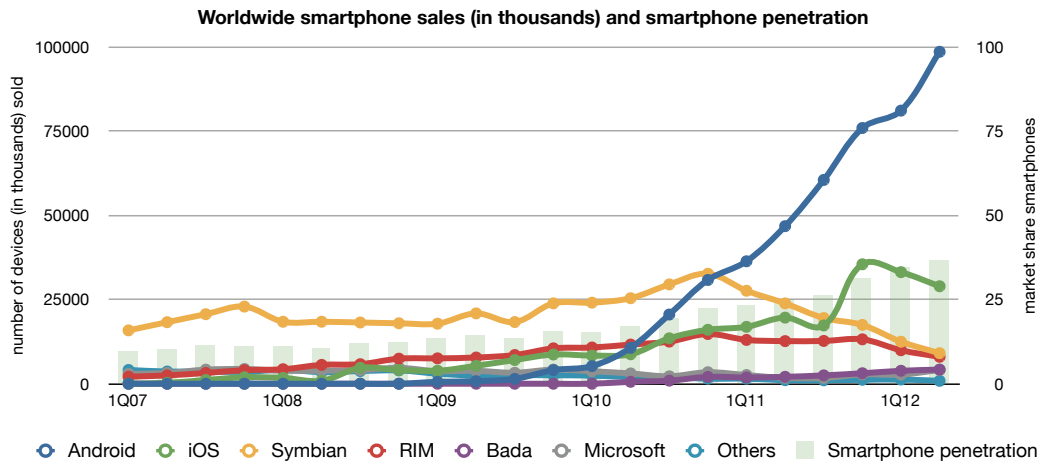


FIGURE 2.1: Growth of worldwide smartphone sales and smartphone penetration. Source: Gartner [3, 4, 5, 6, 7, 8, 9, 12, 13, 10, 14, 15, 16]

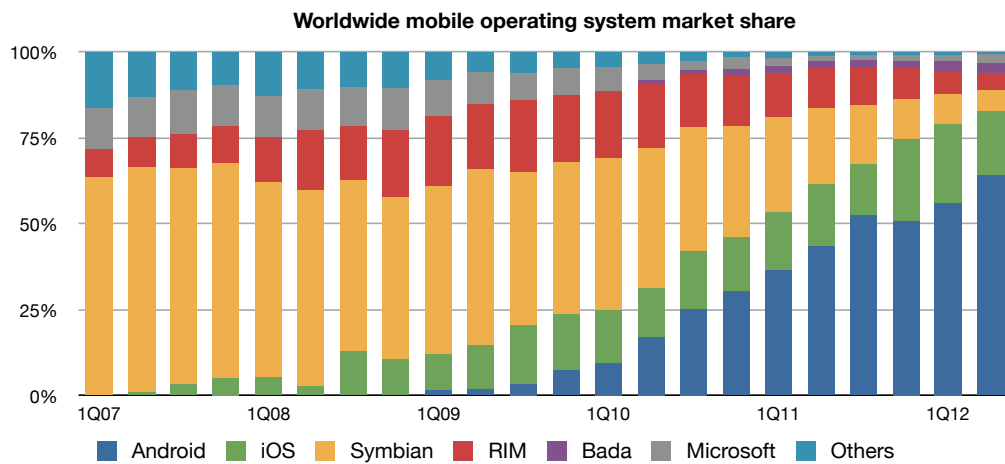


FIGURE 2.2: Growth of worldwide smartphone operating system market share. Source: Gartner [3, 4, 5, 6, 7, 8, 9, 12, 13, 10, 14, 15, 16]

2.3. Strategies for cross platform development

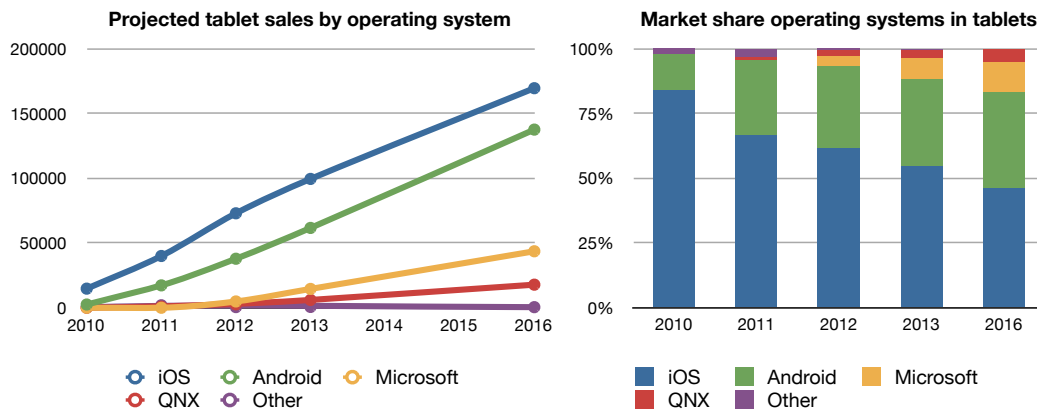


FIGURE 2.3: Growth of worldwide smartphone sales and smartphone penetration. Source: Gartner [11, 17]

there are, the easier it is for a consumer to pick one that fits his needs. For developers on the other hand, fragmentation is usually considered bad. Developers have to develop and test their applications on multiple devices to be able to guarantee the desired experience. This is expensive and time consuming.

From Figure 2.2 and Figure 2.3 it is already clear that the market is divided by operating system or platform but even within these platforms, fragmentation is multi-dimensional [20].

In general, there are fewer fragmentation problems with Apple's iOS because it is a closed platform. Android, however, is an open source platform and vendors are allowed to tailor it for their devices. As a result, there are hundreds of Android based devices but also hundreds of Android flavours.

Maintenance of such Android flavours is expensive and for this reason, manufacturers do not often provide updates for their devices. This has led to noticeable runtime fragmentation among Android based devices (see Figure 2.2). Compared to iOS, this is a serious issue.

Fragmentation on the device axis is unavoidable but, again, fragmentation among Android based devices is worse than among iDevices. The most relevant items on this axis are the different hardware specifications and screen resolution.

2.3 Strategies for cross platform development

There are already a number of paradigms for cross platform mobile application development [2]. This section presents an overview of the available strategies by comparing

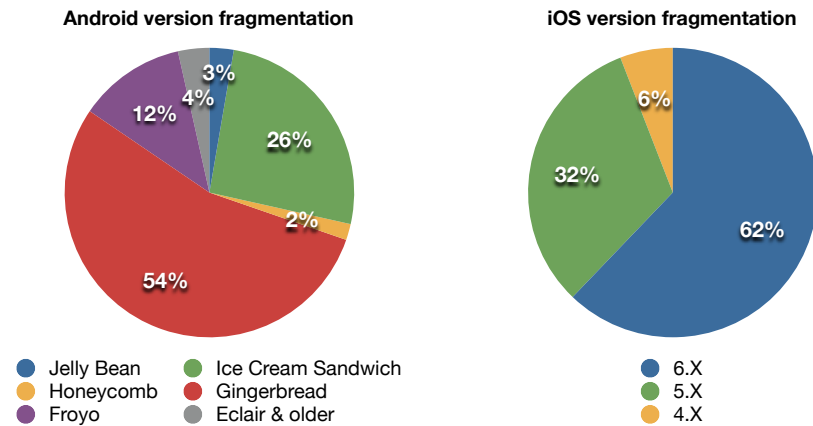


FIGURE 2.4: Runtime fragmentation for Android (data collected by Google during a 14-day period ending on November 1, 2012) [1] and iOS (based on the statistics of developer David Smith) [22].

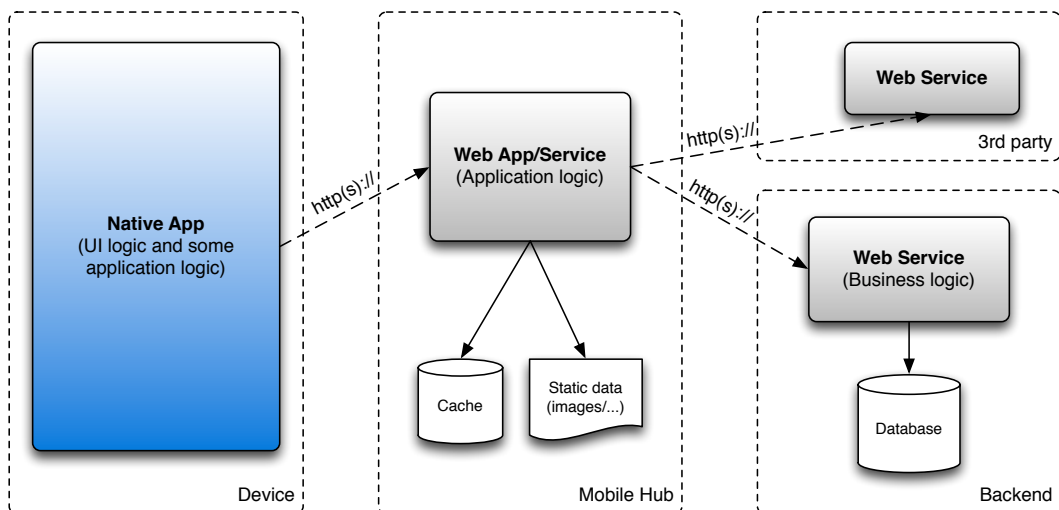


FIGURE 2.5: Overall architecture of a native app.

different aspects: performance, look and feel, platform access, programming languages, development cost and distribution.

2.3.1 Native App

A native app is an application that is specifically designed to run on a particular platform. It is the default approach to develop applications for mobile devices. Figure 2.5 shows an illustration of the overall architecture of such an app.

FIGURE 2.6: Overall architecture of a web app.

FIGURE 2.7: Application architecture of a hybrid app, based on [2]

Native apps are developed with the supplied SDK. Developers will need to get acquainted with the programming language used by said SDK but in return they will get full access to the platform and its features. As a result, the best performance can be obtained with this kind of app.

For the user interface, developers can use lots of interface elements such that they can present a familiar look and feel to the end user.

Native apps can be easily distributed through an online marketplace like for instance the App Store or Google Play.

Because native apps are designed to run on one platform only, this development strategy is not very well suited for cross platform development. If an application should run on multiple platforms, it has to be developed for each platform separately.

2.3.2 Web App

Web apps are websites that are optimized for mobile browsers. Since every platform comes with a browser, this is the easiest way to get an application running on all platforms. An overview of the overall architecture for this kind of app is given in Figure 2.6.

Web apps are not nearly as powerful as native apps. First of all, websites are built with web technologies like HTML. Second,

With HTML5, web apps can even make use of more powerful features like databases, geolocation, etc. The only barrier for now is the incomplete HTML5 support on mobile browsers.

2.3.3 Hybrid App

Hybrid applications are the logical next step, combining native apps and web apps. The actual application is a web site, wrapped in a web view, part of a native shell. Except for the name and some specific extensions, this shell can be reused. Platform access is provided through a bridge (see Figure 2.7).

FIGURE 2.8: Application architecture of an interpreted app, based on [2]

FIGURE 2.9: Architecture used to create cross compiled apps, based on [2]

	Native App	Web App	Hybrid App	Interpreted App	Cross Compiling
Performance					
Look & Feel					
Distribution					

TABLE 2.1: Summary of cross platform mobile application development strategies

2.3.4 Interpreted App

In an interpreted application, instructions are translated to native instructions at run-time.

2.3.5 Cross Compiling

Instead of translating instructions at runtime, one can translate instructions at compile time. The process is called cross compiling and the result is a truly native app. Performance is similar to native apps but

2.3.6 Summary

2.4 Reflection

2.5 Conclusion

Appendices

Bibliography

- [1] Android. Platform Versions, Screen Sizes and Densities and Open GL Version. URL <http://developer.android.com/about/dashboards/index.html>. Accessed on 02/11/2012.
- [2] Peter Friese. Cross platform mobile development, 2012. URL <http://www.slideshare.net/peterfrieese/cross-platform-mobile-development-11239246>. Accessed on 02/11/2012.
- [3] Gartner. Gartner Says Worldwide Smartphone Sales Grew 16 Per Cent in Second Quarter of 2008, 2008. URL <http://www.gartner.com/it/page.jsp?id=754112>. Accessed on 02/11/2012.
- [4] Gartner. , 2008. URL <http://www.gartner.com/it/page.jsp?id=827912>. Accessed on 02/11/2012.
- [5] Gartner. Gartner Says Worldwide Smartphone Sales Reached Its Lowest Growth Rate With 3.7 Per Cent Increase in Fourth Quarter of 2008, 2009. URL <http://www.gartner.com/it/page.jsp?id=910112>. Accessed on 02/11/2012.
- [6] Gartner. Gartner Says Worldwide Mobile Phone Sales Grew 17 Per Cent in First Quarter 2010, 2010. URL <http://www.gartner.com/it/page.jsp?id=1372013>. Accessed on 02/11/2012.
- [7] Gartner. Gartner Says Worldwide Mobile Device Sales Grew 13.8 Percent in Second Quarter of 2010, But Competition Drove Prices Down, 2010. URL <http://www.gartner.com/it/page.jsp?id=1421013>. Accessed on 02/11/2012.
- [8] Gartner. Gartner Says Worldwide Mobile Phone Sales Grew 35 Percent in Third Quarter 2010; Smartphone Sales Increased 96 Percent, 2010. URL <http://www.gartner.com/it/page.jsp?id=1466313>. Accessed on 02/11/2012.
- [9] Gartner. Gartner Says Worldwide Mobile Device Sales to End Users Reached 1.6 Billion Units in 2010; Smartphone Sales Grew 72 Percent in 2010, 2011. URL <http://www.gartner.com/it/page.jsp?id=1543014>. Accessed on 02/11/2012.

- [10] Gartner. Gartner Says Sales of Mobile Devices Grew 5.6 Percent in Third Quarter of 2011; Smartphone Sales Increased 42 Percent, 2011. URL <http://www.gartner.com/it/page.jsp?id=1848514>. Accessed on 02/11/2012.
- [11] Gartner. Gartner Says Apple iOS to Dominate the Media Tablet Market Through 2015, Owning More Than Half of It for the Next Three Years, 2011. URL <http://www.gartner.com/it/page.jsp?id=1626414>. Accessed on 02/11/2012.
- [12] Gartner. Gartner Says 428 Million Mobile Communication Devices Sold Worldwide in First Quarter 2011, a 19 Percent Increase Year-on-Year, 2012. URL <http://www.gartner.com/it/page.jsp?id=1689814>. Accessed on 02/11/2012.
- [13] Gartner. Gartner Says Sales of Mobile Devices in Second Quarter of 2011 Grew 16.5 Percent Year-on-Year; Smartphone Sales Grew 74 Percent, 2012. URL <http://www.gartner.com/it/page.jsp?id=1764714>. Accessed on 02/11/2012.
- [14] Gartner. Gartner Says Worldwide Smartphone Sales Soared in Fourth Quarter of 2011 With 47 Percent Growth, 2012. URL <http://www.gartner.com/it/page.jsp?id=1924314>. Accessed on 02/11/2012.
- [15] Gartner. Gartner Says Worldwide Sales of Mobile Phones Declined 2 Percent in First Quarter of 2012; Previous Year-over-Year Decline Occurred in Second Quarter of 2009, 2012. URL <http://www.gartner.com/it/page.jsp?id=2017015>. Accessed on 02/11/2012.
- [16] Gartner. Gartner Says Worldwide Sales of Mobile Phones Declined 2.3 Percent in Second Quarter of 2012, 2012. URL <http://www.gartner.com/it/page.jsp?id=2120015>. Accessed on 02/11/2012.
- [17] Gartner. Gartner Says Worldwide Media Tablets Sales to Reach 119 Million Units in 2012, 2012. URL <http://www.gartner.com/it/page.jsp?id=1980115>. Accessed on 02/11/2012.
- [18] IDC. Android Expected to Reach Its Peak This Year as Mobile Phone Shipments Slow, According to IDC, 2012. URL <http://www.idc.com/getdoc.jsp?containerId=prUS23523812>. Accessed on 2/11/2012.
- [19] IDC. IDC Raises Its Worldwide Tablet Forecast on Continued Strong Demand and Forthcoming New Product Launches, 2012. URL <http://www.idc.com/getdoc.jsp?containerId=prUS23696912>. Accessed on 2/11/2012.
- [20] Charlie Kindel. Fragmentation Is Not The End of Android, 2012. URL <http://ceklog.kindel.com/2012/01/14/fragmentation-is-not-the-end-of-android/>. Accessed on 02/11/2012.
- [21] Nielsen. Smartphones Account for Half of all Mobile Phones, Dominate New Phone Purchases in the US, 2012. URL http://blog.nielsen.com/nielsenwire/online_mobile/

smartphones-account-for-half-of-all-mobile-phones-dominate-new-phone-purchases-in-
Accessed on 02/11/2012.

- [22] David Smith. iOS Version Stats. URL <http://david-smith.org/iosversionstats/>. Accessed on 02/11/2012.

Fiche masterproef

Student: Michiel Staessen

Titel: Comparative study of tools for cross-platform mobile application development

Nederlandse titel: ""

UDC:

Korte inhoud:

Here comes a very short abstract, containing no more than 500 words. \LaTeX commands can be used here.

Thesis voorgedragen tot het behalen van de graad van Master of Science in de ingenieurswetenschappen: computerwetenschappen, hoofdspecialisatie Software engineering

Promotor: prof. dr. ir. Erik Duval

Assessor:

Begeleider: ir. Gonzalo Parra