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Faculteit
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Comparative study of tools for cross-platform mobile application development

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

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Preface

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Contents

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.

Chapter

2 Literature Study

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% [23]. 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 [20].

A similar scenario is playing in the tablet industry. According to other studies by both Gartner [13, 19] and IDC [21], 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

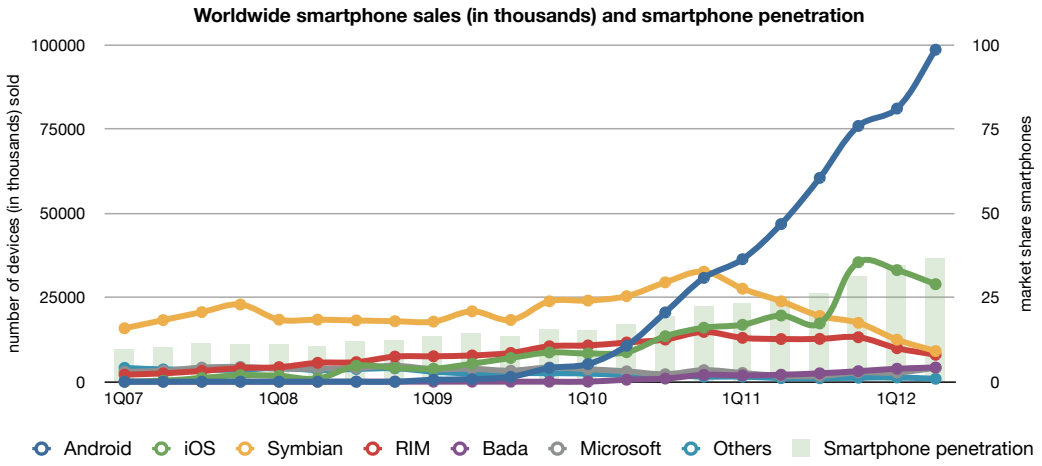

FIGURE 2.1: Growth of worldwide smartphone sales and smartphone penetration. Source: Gartner [5, 6, 7, 8, 9, 10, 11, 14, 15, 12, 16, 17, 18]

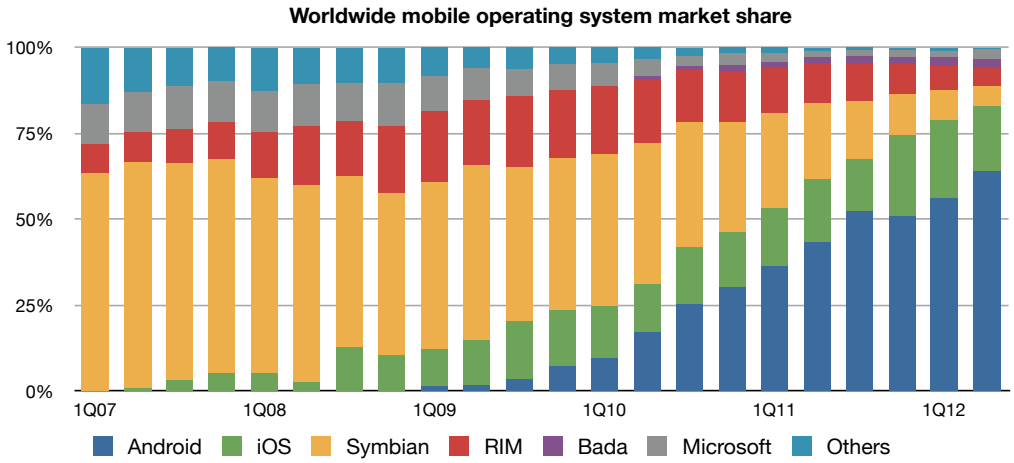

FIGURE 2.2: Growth of worldwide smartphone operating system market share. Source: Gartner [5, 6, 7, 8, 9, 10, 11, 14, 15, 12, 16, 17, 18]

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 [22].

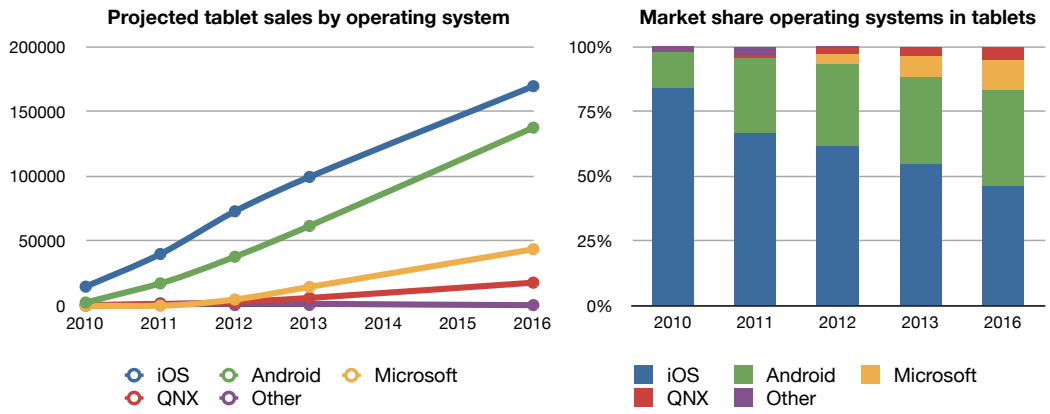

FIGURE 2.3: Growth of worldwide smartphone sales and smartphone penetration. Source: Gartner [13, 19]

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.

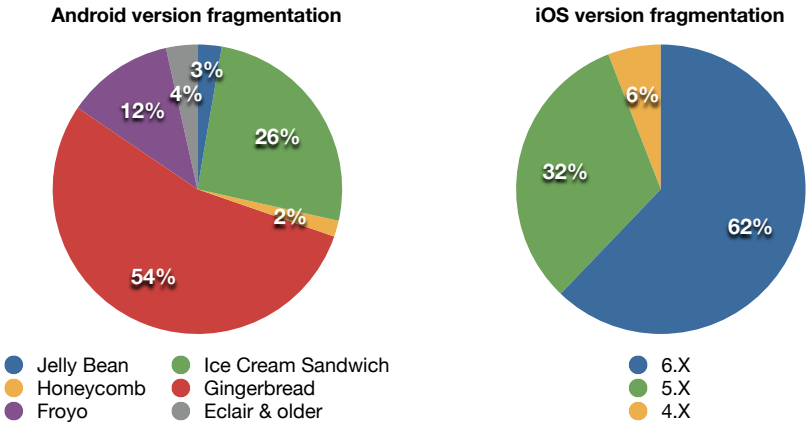

FIGURE 2.4: Runtime fragmentation for Android (data collected by Google during a 14-day period ending on November 1, 2012) [1] and iOS (based on the statistics of developer David Smith) [24].

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 [4]. This section presents an overview of the available strategies by comparing 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.

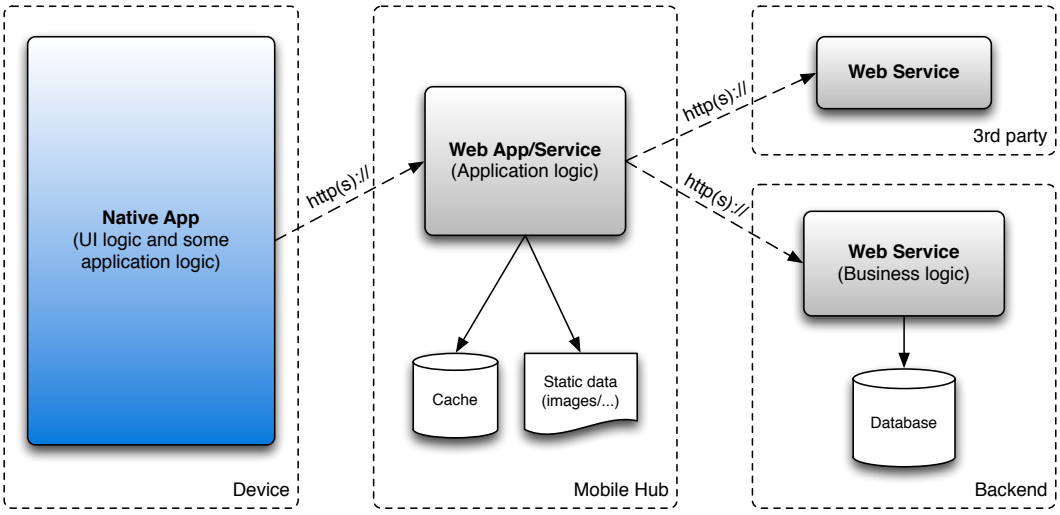

FIGURE 2.5: Overall architecture of a native app.

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. This is costly.

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.

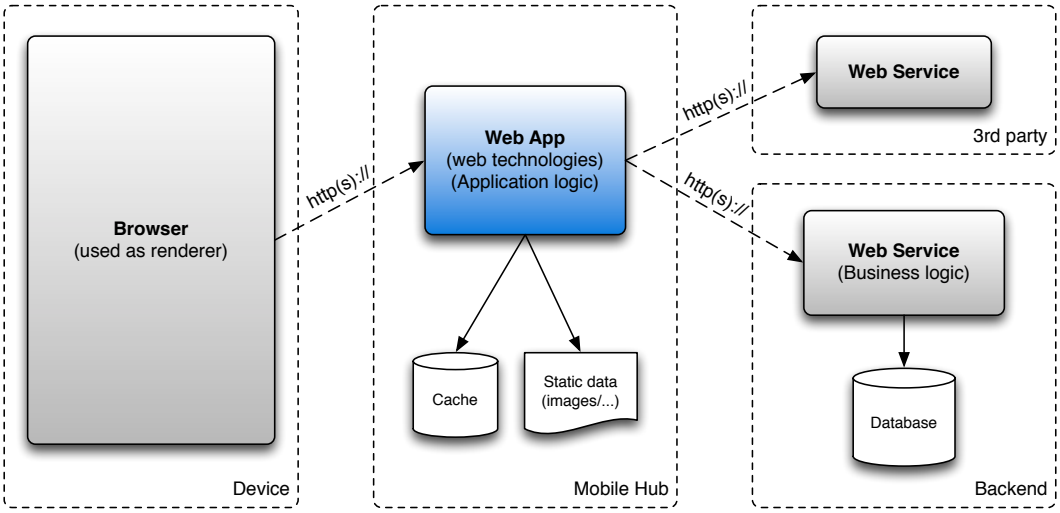

FIGURE 2.6: Overall architecture of a web app.

Web apps are not nearly as powerful as native apps. First of all, the application is not stored on the device. Web apps require an active internet connection which cannot always be guaranteed. Second, they are built with web technologies like HTML, CSS and JavaScript, which have to be interpreted by the browser at runtime. Third, web apps cannot access the system which means they cannot make use of the many unique features of a mobile device.

With HTML5, web apps can get more powerful. They will be able to access device features, like the camera and other sensors [3]. They will not even require an active internet connection because they can be cached on the device. However, HTML5 is still a draft and a lot of mobile browsers lack proper HTML5 support.

From a user interface perspective, web apps can be a problem as well.

Web apps are distributed easily: the only requirement is a valid URL. Web apps cannot be installed on the device though, but there are workarounds using Web Clips on iOS [2] and bookmarks on Android.

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, embedded in a web view, part of a native wrapper. The embedded website can access (parts of) the system through a bridge. An overview of the overall architecture is shown in Figure 2.7.

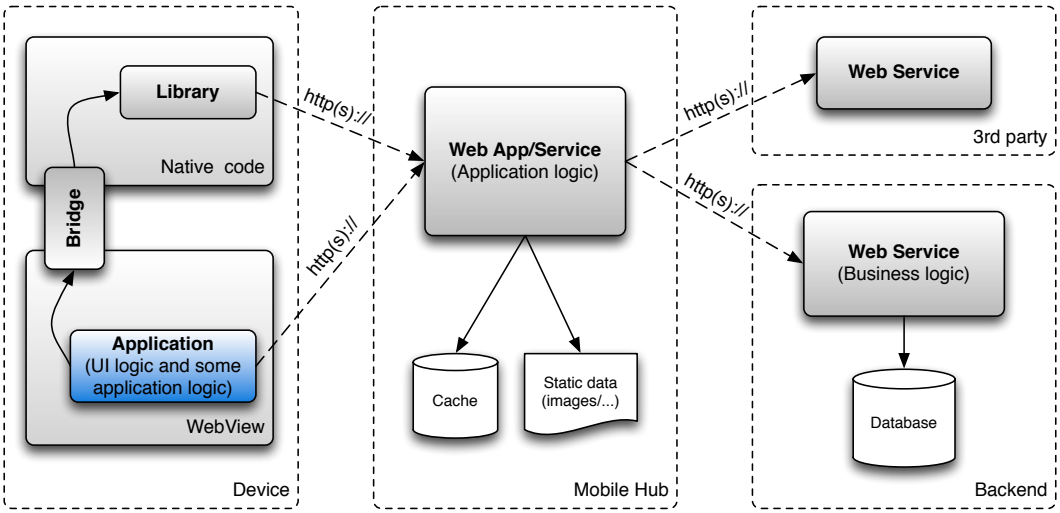

FIGURE 2.7: Overall architecture of a hybrid app.

Hybrid apps are part native app, part web app. Performance will be similar to web apps but some parts can be optimized by using native code. The websites inside the hybrid app are also much more powerful because they can access many device features that aren't available in HTML(5) through the bridge.

When it comes to the user interface, hybrid apps suffer from the same problem as web apps.

Because hybrid apps are wrapped in a native container, they can be distributed just like native applications, through online marketplaces.

2.3.4 Interpreted App

In an interpreted app, instructions in some language are translated to native instructions at runtime. Figure 2.8 shows the overall architecture of an interpreted app.

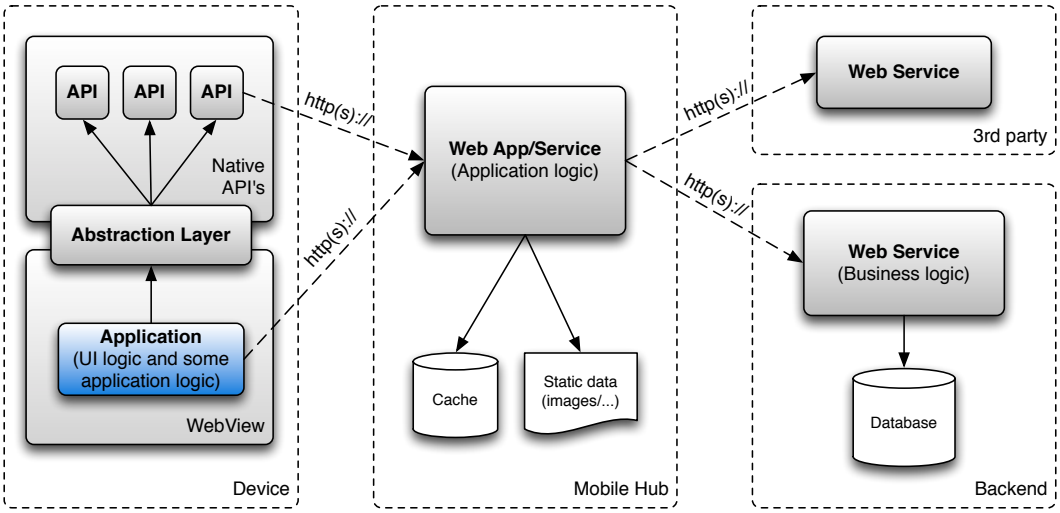

FIGURE 2.8: Overall architecture of an interpreted app.

Performance of interpreted apps depends on the interpreter and interpreted language but is better than web apps on average, though not as good as native apps.

In an interpreted app, the user interface description is interpreted and rendered on the device using native interface elements. An interpreted app will have a familiar look and feel.

From the outside, interpreted apps – just like hybrid apps – look like native apps and can be distributed through online marketplaces.

2.3.5 Cross Compiling

Instead of translating instructions at runtime, one could translate instructions at compile time. The process is called cross compiling and the result is a truly native app. The overall architecture is sketched in Figure 2.9.

2.3.6 Summary

Table 2.1 summarizes the results of the discussed strategies. It is important to note that there is no universal strategy that fits all use cases. A strategy must be chosen carefully, taking into account the client's wishes.

2.4 Conclusion

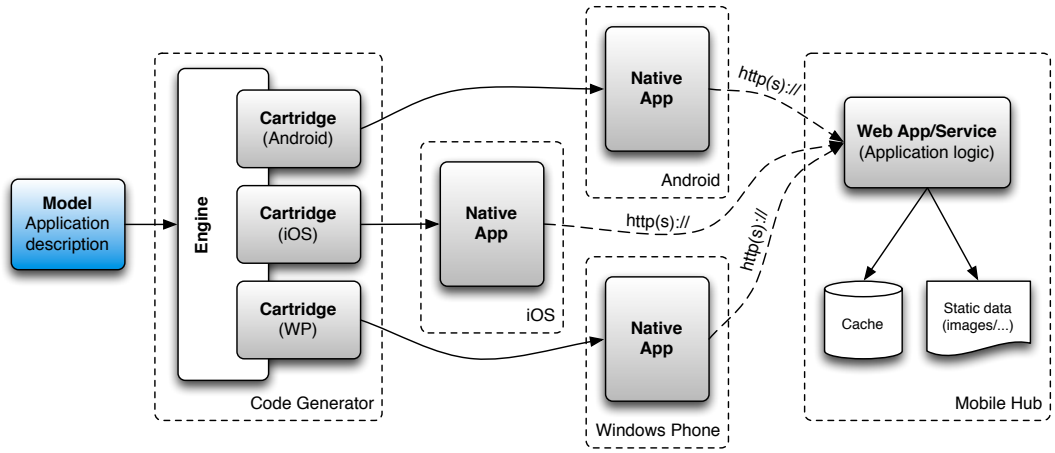

FIGURE 2.9: Overall architecture for cross compiled apps.

	Native	Web	Hybrid	Interpreted	Cross Compiled
Performance	high	low	rather low	average	high
Platform Access	✓	× / ✓	✓	✓	✓
Look & Feel	native	non-native	non-native	native	native
Distribution	marketplace	URL	marketplace	marketplace	marketplace
Development cost	high	rather low	average	average	average

TABLE 2.1: Summary of cross platform mobile application development strategies.

Appendices

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Fiche masterproef

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

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