

# Web-based Hybrid Mobile Apps: State of the Practice and Research Opportunities

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## ABSTRACT

This paper describes the contents of a tutorial on web-based hybrid mobile apps. Nowadays millions of mobile apps are downloaded and used all over the world. Mobile apps are distributed via different app stores like Google Play Store, the Apple App Store, the Windows Phone Store. One of the most intriguing challenges in mobile apps development is its fragmentation with respect to mobile platforms (e.g., Android, Apple iOS, Windows Phone). Recently, companies like IBM and Adobe and a growing community of developers advocate web-based hybrid mobile apps development as a possible solution to mobile platforms fragmentation. Web-based hybrid mobile apps are consistent across platforms and built on web standards like HTML5, CSS3, JavaScript.

This tutorial provides a state of the art overview of the solutions, technologies, and research opportunities related to the development of web-based hybrid mobile apps. Apache Cordova is presented as one of the possible technologies for hybrid apps development. The results of two empirical studies performed on real hybrid mobile apps are presented as an up-to-date snapshot of the state of the practice in the field. Research opportunities and an open discussion close the tutorial.

## Keywords

Hybrid mobile apps; Web technologies; App store analysis

## 1. TOPIC DESCRIPTION

Today the total activity on smartphones and tablets accounts for an incredible 60% of the time spent on digital media in the United States [2]. One of the main factors driving mobile's success is mobile apps usage (which alone makes up a majority of total digital media engagement at

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52% [2]). Indeed, the mobile apps market now counts more than two million apps, downloaded billions of times per year from a number of dedicated app stores. A recent market research report from ResearchMoz [10] confirms that two are the most popular app stores: the Google Play Store for Android apps (with 62.6 millions of users), and the Apple App Store for iOS apps (with 76.1 millions of users).

However, programming languages and tools for developing mobile apps are platform-specific, for example, Android apps are created in Java via the Eclipse-based Android SDK, whereas Apple iOS apps are developed using either Objective-C or Swift via the XCode tool [1]. As a result, the development and maintenance of native apps for multiple platforms is one of the major technical challenges affecting the mobile development community [6].

As a solution, large companies like IBM and Adobe, and many independent developers are investing resources and effort on the so-called *web-based hybrid mobile apps*. In this context, web-based hybrid mobile apps allow developers to use standardized web technologies such as HTML, CSS, and JavaScript, and distribute them in app stores via cross-platform wrappers and tools [5, 11]. If on one side hybrid mobile apps give numerous benefits, such as cross-platform portability, the reuse of existing knowledge of web developers, simpler and less expensive development processes [1], on the other side they suffer from a number of shortcomings such as restricted access to hardware features, variations on user experience, decrease in performance. Today there is a strong debate about benefits and drawbacks in hybrid app development and the raised interests around the topic is testified by the existence of a significant corpus of research works [7, 8, 9, 4, 3].

## 2. FORMAT OF THE TUTORIAL

The tutorial introduces, enlightens, and intrigues the audience on the topic of web-based hybrid mobile apps development. The intended audience of the tutorial is both researchers and practitioners willing to learn and discuss advantages and disadvantages of web-based hybrid mobile apps from both a research and practical points of view.

The length of the tutorial is 90 minutes, divided into the following four main parts:

1. **Web-based hybrid mobile apps (20 minutes):** this part of tutorial exposes the audience to the problem of apps fragmentation with respect to mobile platforms; then the presenter discusses the practice of hybrid mobile apps development as one of the possible solutions to the fragmentation problem. For the sake

of completeness, the presenter also briefly discusses the other most common mobile development strategies (i.e., native apps and mobile web apps).

2. **Hybrid Apps in the Google Play Store (20 minutes)**: this part of tutorial is based on two empirical investigations performed by the presenter together with other researchers from the Gran Sasso Science Institute (Italy), the University of Leipzig (Germany), and the Hong Kong University of Science and Technology (China) [7, 8]. Goal of this part of tutorial is to identify and analyse the traits and distinctions of *publicly available hybrid mobile apps*; in this context, real hybrid mobile apps have been analyzed from both a technical and end users' perception perspective. The studies have been conducted by mining 11,917 free apps and 3,041,315 reviews from the Google Play Store.
3. **Interactive session with Apache Cordova (30 minutes)**: this part of tutorial focusses on Apache Cordova<sup>1</sup>, i.e., an open-source hybrid mobile development framework. Goal of this part of tutorial is to concretely show how hybrid mobile apps can be developed using standard web technologies like HTML5, CSS3, and JavaScript. More specifically, in this part of tutorial the presenter performs an *interactive live session* in which he programs together with the audience a basic mobile application using Apache Cordova, showing standard mobile-oriented capabilities like detecting the geographical position of the user via the GPS sensor, capturing a photo using the device's camera, etc.
4. **Research Opportunities and discussion (20 minutes)**: this part of tutorial discusses the opportunities that future researchers can catch when investigating on hybrid mobile apps, hopefully triggering fruitful interactions with the audience and setting up a shared research plan with potential collaborations.

It is important to note that the interactive session is not be performed at the end of the tutorial in order to directly expose the audience to the concrete issues and problems developers may face while developing hybrid mobile apps; those issues are be the base of the discussion performed in the last part of the tutorial.

### 3. EQUIPMENT

The tutorial requires only the standard conference equipment, such as a projector, a projection screen, and a microphone. The tutorial does not require the participants to bring any additional equipment.

### 4. BIOGRAPHY OF THE PRESENTER

Ivano Malavolta is a postdoctoral researcher at the Gran Sasso Science Institute, Italy. His research focuses on software architecture, model-driven engineering, and mobile-enabled systems, especially how MDE techniques can be exploited for architecting complex and mobile-enabled software systems at the right level of abstraction. He is program committee member and reviewer of international conferences

<sup>1</sup><http://cordova.apache.org>

and journals in his fields of interest. He is a strong advocate of applying academic research results in real scenarios, and he is working on projects that have been awarded as the most innovative solutions in both national and international venues. Malavolta received a PhD in computer science from the University of L'Aquila, Italy. He is a member of ACM and IEEE. Finally, he is a mobile applications developer with around thirty projects in his portfolio, the majority of which developed using web technologies and hybrid mobile development frameworks.

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