



**AIN SHAMS UNIVERSITY**  
**FACULTY OF ENGINEERING**  
**Computer and Systems Engineering Department**

# **Cross-Platform Mobile Development**

A Thesis

Submitted in Partial Fulfillment of the Requirements of the Degree of  
Master of Science in Electrical Engineering  
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## **Statement**

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering (Computer and Systems Engineering), Faculty of Engineering, Ain shams University, Cairo, Egypt.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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# Abstract

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Smartphones become much more used these days than feature phones and personal computers because of the variety of mobile applications that are available to be downloaded from the application stores. There are many smartphones’ vendors in the market and each vendor uses a different mobile platform. Each platform vendor provides different development tools and programming languages for the developers. Therefore, the development of the same application for different platforms means repeating the same work several times; each time using the programming language and development tools of a specific mobile platform. Cross-platform mobile development solutions solve this problem by having a main concept. This concept is enabling the developer to develop the application once and run it anywhere. The cross-platform solutions use different approaches for native development such as: Cross-Compilation, Interpretation, Model-Driven Development, Component-Based ...etc. This thesis surveys the existing cross-platform mobile development approaches, attempts to propose a comprehensive categorization for them, defines the pros and cons of each approach, and explains sample solutions per approach. The survey defines the limitations of the existing cross-platform solutions and the open research areas. This thesis introduces an Integrated Cross-Platform Mobile Applications Development (ICPMD) solution which attempts to enhance the limitations of the existing solutions by: (1) helping the developer to develop with the most popular programming languages like Java for Android and C# for Windows Phone, (2) focusing on both the source code and user interface transformations to generate full applications, and (3) supporting code reuse. The ICPMD supports two platforms: Windows Phone 8 and Android. This thesis proposes and implements a new code conversion approach by using the Extensible Stylesheet Language Transformation (XSLT) and Regular Expressions. The implemented approach is used to convert several mobile applications from the Windows Phone 8 platform to the

Android platform and vice versa. The thesis compares the generated application from the proposed ICPMD approach to its native counterpart and to generated applications from two commercial tools (Titanium, and Xamarin). The evaluation of the ICPMD generated applications shows substantial improvement over the existing cross-platform mobile development solutions.

**Keywords:** Mobile Applications; Cross-Platform Mobile Development; Trans-Compilation; Model Driven Development; Code Conversion; Code Reuse; Code Generation;

# Summary

## “Cross-Platform Mobile Development”

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This thesis introduces an Integrated Cross-Platform Mobile Applications Development (ICPMD) solution to enhance the limitations of the existing cross-platform mobile development solutions by: 1) helping the developer to develop with the most popular programming languages like Java for Android and C# for Windows Phone, 2) generating full mobile applications by focusing on both the source code and user interface transformations, and 3) supporting code reuse. This thesis compares the generated application from the proposed ICPMD solution to its native counterpart and to applications that are developed by using two commercial tools: Titanium, and Xamarin. The evaluation of the ICPMD generated applications shows substantial improvement over the existing cross-platform mobile development solutions.

**Chapter 1** introduces the thesis and summarizes its contributions.

**Chapter 2** presents a background about the mobile applications development.

**Chapter 3** presents the literature survey of the cross-platform mobile applications development approaches and sample solutions per approach.

**Chapter 4** presents the proposed solution (ICPMD) and illustrates the building blocks of the proposed architecture along with the internal design details of the ICPMD main modules.

**Chapter 5** introduces the proposed code conversion approach which is based on the XSLT and Regular Expressions.

**Chapter 6** introduces the implementation results of the ICPMD.

**Chapter 7** presents the evaluation criteria and results of: 1) evaluating the proposed code conversion approach, and 2) comparing the generated application from ICPMD to its native counterpart and to the output applications from other cross-platform solutions in commercial use.

**Chapter 8** gives the work conclusions and future work.

References and appendixes exist at the end of this thesis.

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# List of Abbreviations

<b>ACL</b>	Android Compatibility Library
<b>ADT</b>	Android Development Tool
<b>AMS</b>	Authentication and Management System
<b>AOT</b>	Ahead of Time Compilation
<b>API</b>	Application Programming Interface
<b>App</b>	Mobile Application
<b>ARM</b>	Advanced RISC Machine
<b>ASEJ</b>	Ain Shams Engineering Journal
<b>AST</b>	Abstract Syntax Tree
<b>CDLOC</b>	Correctly Detected Lines of Code
<b>CI</b>	Cloud Infrastructure
<b>CLR</b>	Common Language Runtime
<b>CRUD</b>	Create, Retrieve, Update, and Delete operations
<b>DOM</b>	Document Object Model
<b>DSL</b>	Domain Specific Language
<b>GCC</b>	GNU Compiler Collection
<b>GUI</b>	Graphical User Interface
<b>GWT</b>	Google Web Toolkit
<b>ICPMD</b>	Integrated Cross-Platform Mobile Development
<b>IDE</b>	Integrated Development Environment
<b>IMEI</b>	International Mobile Equipment Identity
<b>IPR</b>	Intellectual Property Right
<b>Java ME</b>	Java Mobile Edition
<b>JIL</b>	Joint Innovation Lab
<b>JIT</b>	Just in Time Compilation
<b>JSAF</b>	JavaScript Application Framework
<b>JVM</b>	Java Virtual Machine
<b>LOC</b>	Lines of Code
<b>MB-UID</b>	Model-Based User Interface Development