

# The enterprise developer's guide to building five-star mobile apps

Take your .NET skills mobile and create outstanding  
Android, iOS, and Windows apps

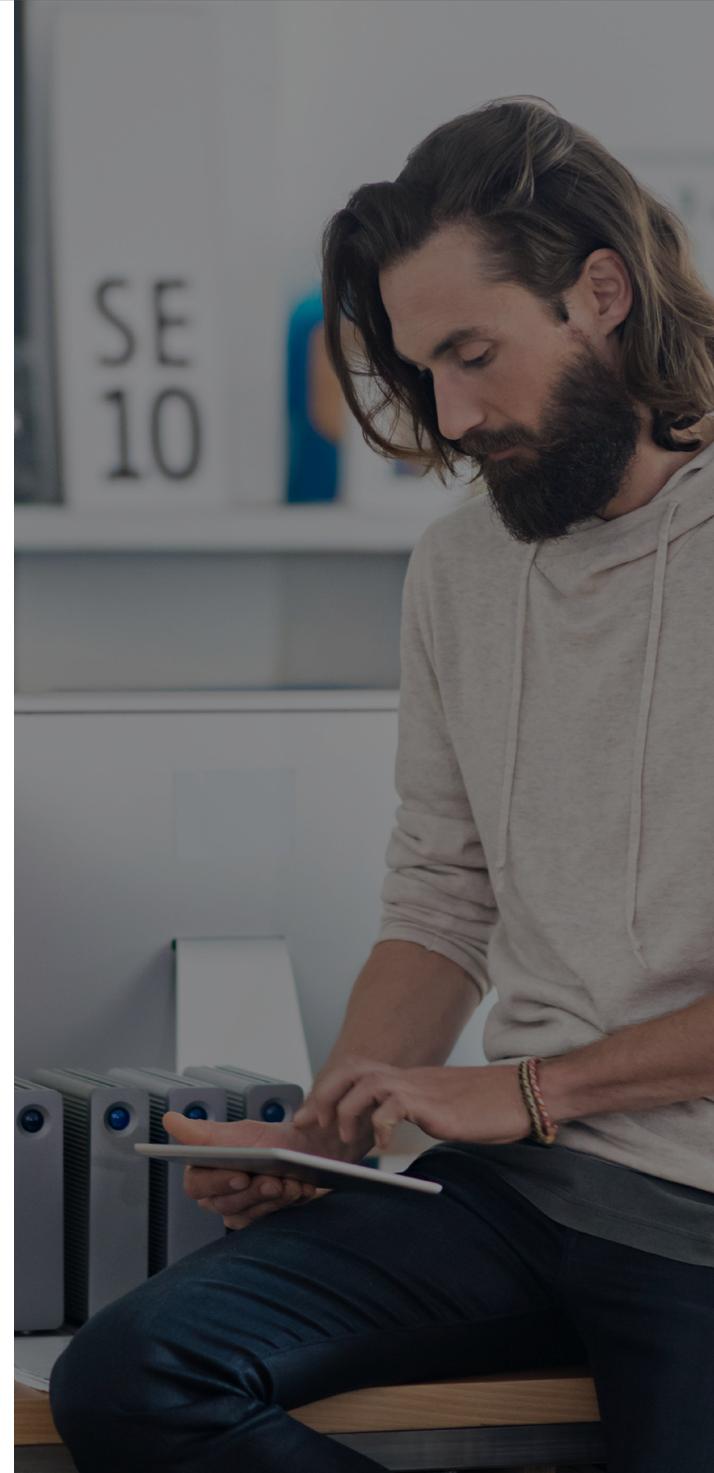
# The state of mobile application development in enterprise organizations

# Why mobile matters

Mobile is one of the largest technology innovations in history, with an adoption rate exceeding all major technology booms: 10 times faster than PCs, twice as fast as the Internet, and three times faster than social media.<sup>1</sup>

In response to the mobile explosion, businesses recognize mobile's strategic competitive advantages and the need to deliver exceptional mobile experiences to customers, employees, and suppliers.

To meet this demand, developers everywhere are adding mobile to their skill sets. Compared to their peers, enterprise developers face unique mobile development challenges.



## Extending your existing business to mobile

Since you have established infrastructure, systems, and processes for developing apps in place, you need to determine how to adapt your business application ecosystem to mobile. This means carefully considering things like:

- Backend systems integration and whether you'll store data on-premises or connect to cloud services.
- Potential security and management implications in an environment where you have less control over user devices and access points.
- How to meet users' high expectations, delivering seamless, intuitive mobile experiences that work well on their device of choice.

## Delivering apps at scale

Enterprise developers also need to plan for not just one, but multiple apps that serve various purposes and audiences. This is known as "appification of modern business." For instance, enterprises are shifting from monolithic apps to individual apps for things like expense reporting, timesheets, and CRM.

Achieving appification is difficult. Not only do you need to deliver high-quality apps across multiple platforms, you also need to maintain them. This means rapidly fixing issues, responding to user feedback, and releasing new features—while the demand for new apps continues to grow.

## By the numbers

# 3

The average number of different devices today's employees use daily<sup>2</sup>

# 5 or 6

The average number of different devices employees are expected to use daily as technologies like Internet of Things (IoT) and wearables become increasingly popular<sup>2</sup>

# 90%

The percentage of enterprises needing to support two or more device platforms<sup>2</sup>

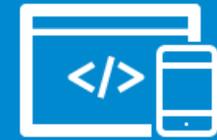


## Succeeding in mobile application development

So how do you meet the exponential demand for amazing mobile apps across multiple platforms and devices, while continuing to use the skills and technology you love?

Microsoft offers an end-to-end technology stack that gives you everything you need to build Android, iOS, and Windows apps. Simplify mobile development and automate your build-to-release pipeline to quickly deliver apps for any use case.

## Microsoft's end-to-end technology stack



Take your skills mobile



Add powerful cloud services



Release great apps faster

## A closer look

This guide shows you how to deliver high-quality mobile experiences using your existing skills and code. Explore the following products by turning to the following sections:

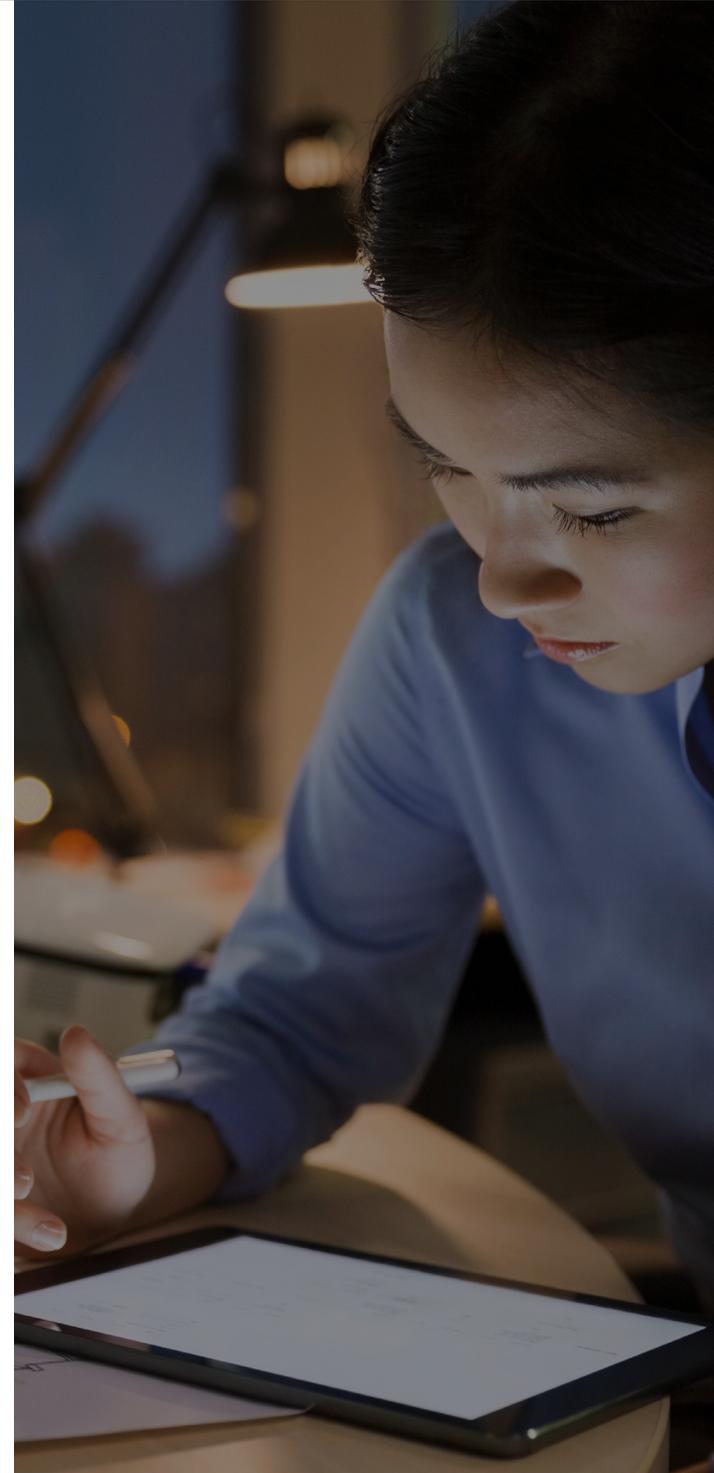
- Visual Studio Enterprise (p. 7): Find out how this integrated, end-to-end solution supports native, hybrid, and web mobile development options for Android, iOS, and Windows apps.
- Xamarin for Visual Studio Enterprise (p. 11): See how Xamarin gives you the ability to quickly build high-performance, fully native Android, iOS, and Windows apps from a single shared C# codebase.
- Microsoft Azure (p. 20): Learn how this flexible, scalable cloud platform allows you to connect your apps to critical mobile services and data stored on-premises or in the cloud.

Throughout this guide, you'll have access to the technical documents, how-to videos, and other resources you need to get started.

### Explore Visual Studio Enterprise

Discover ways to use the advanced features and tools in Visual Studio Enterprise to design and build apps that are ready for continuous integration and continuous delivery.

[Take the course >](#)



# Visual Studio Enterprise for Android, iOS, and Windows

# Why app quality matters

As mobile users ourselves, we have high expectations when it comes to the mobile app experience. *Your* users are no different. Reliability, performance, and design are all factors that can make the difference between a five-star rating and a quick uninstall.

In a world of instant gratification, most user interactions with mobile apps are glances or quick checks, typically lasting less than a minute.<sup>3</sup> Users want relevant information on their device of choice, and they want it immediately. In fact, 60% of users will abandon an app if it doesn't load within three seconds.<sup>3</sup>

Bottom line? First impressions matter. **Visual Studio Enterprise** lets you build mobile apps that meet users' high expectations while reducing your development time and simplifying the process of building new features down the line.



**The future of customer experience hinges on an excellent mobile app experience.<sup>4</sup>**

**Gartner**

**60%**  
of users will  
abandon  
an app if it  
doesn't load  
within three  
seconds.

## Choosing the right mobile development approach

Before you start developing your apps, you need to take several factors into account, including existing code, team skills, and technology investments. As you build for multiple platforms, you don't want to unnecessarily duplicate effort or the number of codebases you'll need to maintain. Additionally, you need a plan to ensure feature parity across platforms, keeping apps up-to-date with new operating system releases.

Each approach has distinct pros and cons when it comes to end-user experience and quality, speed-to-market, and post-release tooling support.

The silo approach results in high-quality user experiences, but it requires multiple teams and lacks comprehensive lifecycle management tooling. While hybrid and web offer more developer productivity advantages and tool support, it's at the expense of mobile quality.

The cross-platform native approach—with Xamarin for Visual Studio Enterprise—allows you to build native Android, iOS, and Windows apps from one codebase, reducing time-to-market, and easily integrates with Microsoft's mobile DevOps technology.

## Mobile development approaches

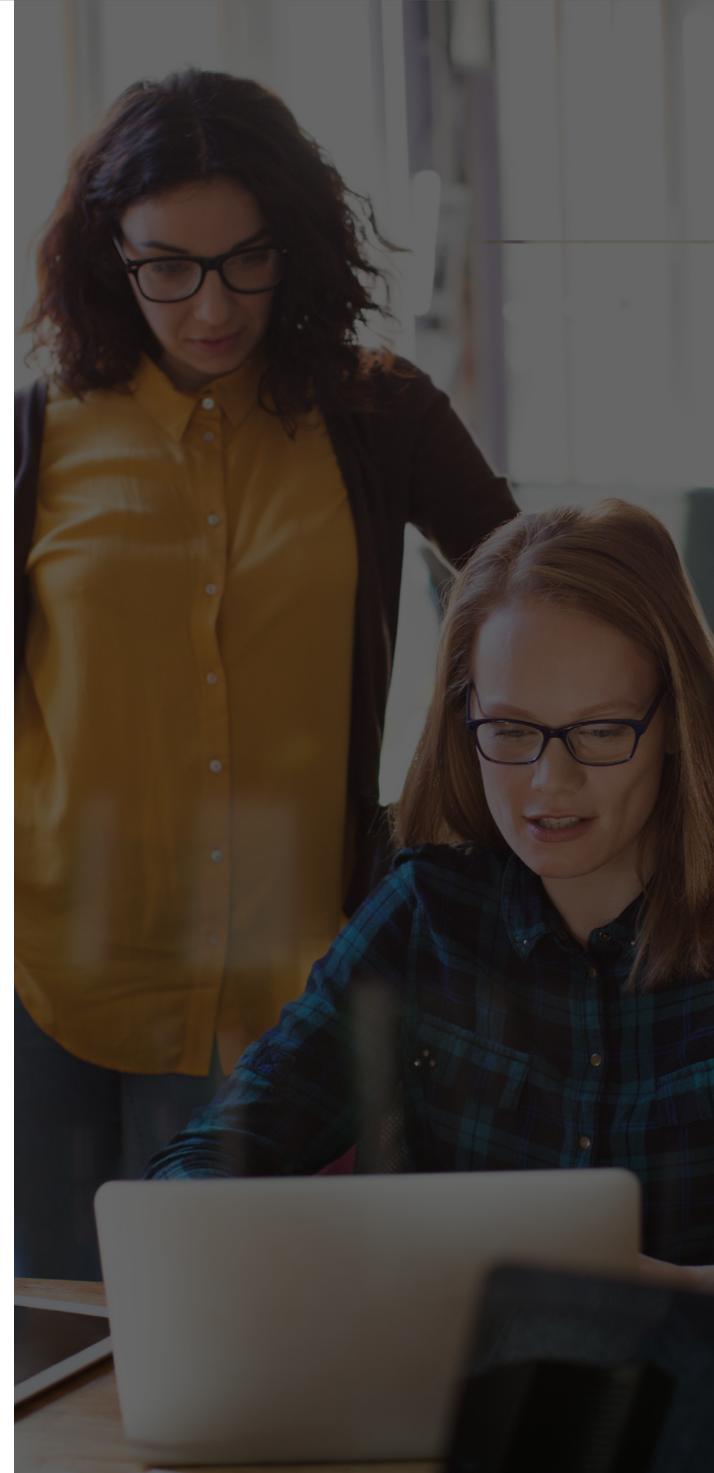
	Platform silos	Hybrid and web	Cross-platform native with Xamarin
	 <p>Obj C C# Java</p>	 <p>HTML 5 JavaScript/TypeScript</p>	 <p>Shared code</p>
<b>User experience</b>	✓ Native experience Maximum performance	✗ Non-native UX Performance compromises	✓ Fully native UI and performance High-fidelity API access
<b>Developer productivity</b>	✗ Multiple codebases Higher TCO and maintenance	✓ Build once, iterate easily Reuse existing web development skills	✓ Only one codebase, one team
<b>Tools</b>	✗ Little or no lifecycle management tool support from platform vendors	✓ Mature tooling, variety of tools	✓ Full-featured, end-to-end lifecycle management and DevOps

## Microsoft supports your choice

No matter which approach you choose, Visual Studio Enterprise allows you to deliver amazing mobile experiences for any platform, form factor, and operating system, all while using the IDE and language you love.

Take a look at the following pages to learn how to get started:

- Native mobile apps with Xamarin for Visual Studio Enterprise (p. 11)
- Hybrid mobile apps with Visual Studio Tools for Apache Cordova (p. 17)
- Web apps with Visual Studio Enterprise (p. 19)



# Build native Android, iOS, and Windows apps faster than ever

## Xamarin for Visual Studio Enterprise

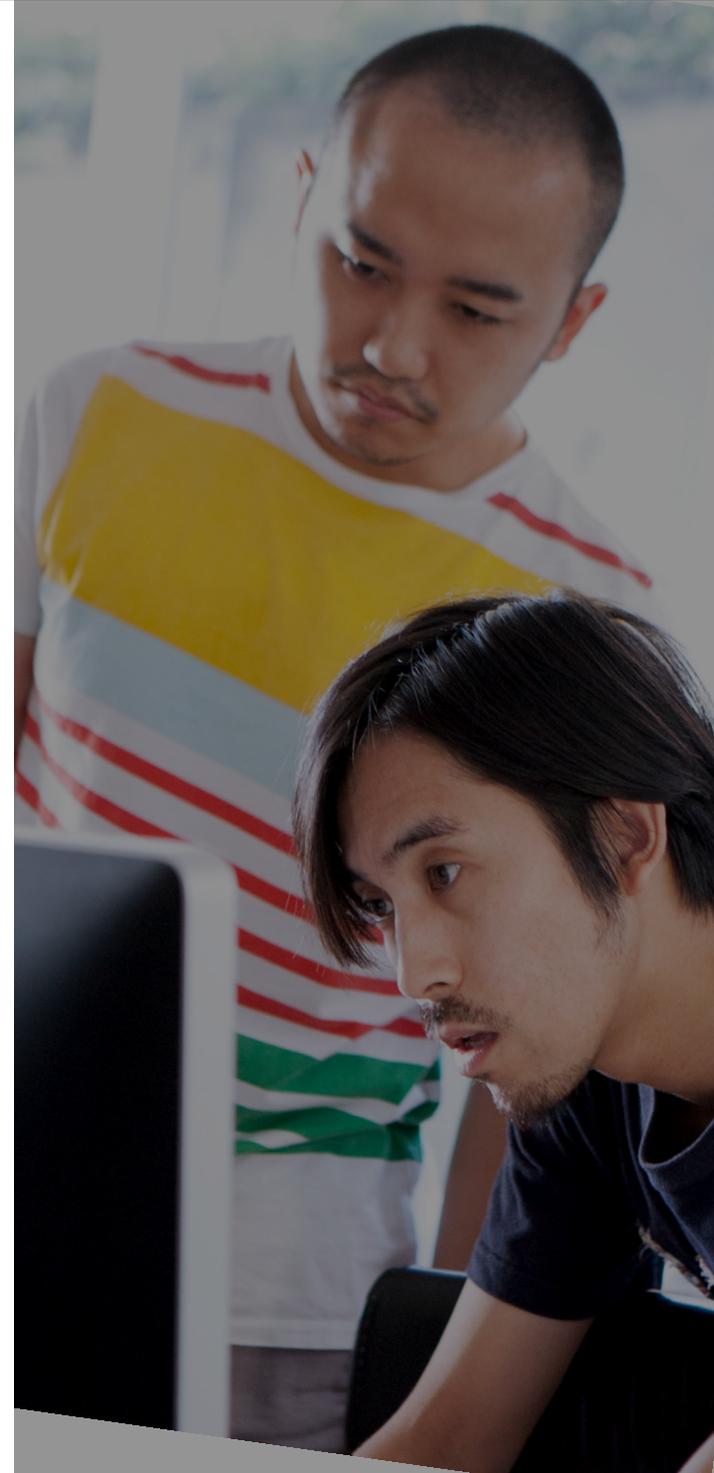
We talked about why quality matters and what users expect in mobile apps—namely high-quality features, UI, performance, and usability. When you consider these qualities and expectations, a fully native app may be the best development approach versus hybrid and web, regardless of whether you're building for customers, businesses, employees, or suppliers.



**Our mobile apps give us the unique ability to reach our customers in new ways, and Xamarin frees us to focus on building better apps, faster. We don't think about our toolchain, we think about our customers.**

Director Mobile Development

*insightly*



## What makes native apps different?

There are three core attributes that differentiate native apps from non-native (hybrid and web) apps: native UI, high-fidelity API access, and native performance.

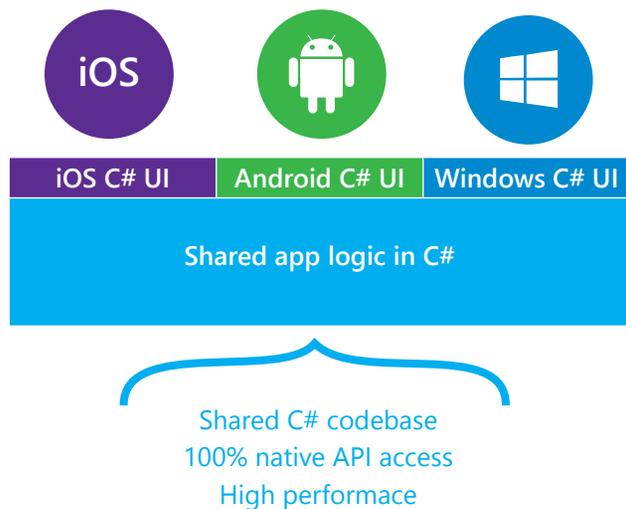
## The native app anatomy checklist

	Native UI	Native API	Native performance
Native	<ul style="list-style-type: none"><li>✓ Access to 100% of the UI APIs</li><li>✓ Access to 100% of the properties of the UI API</li><li>✓ Controls rendered using the underlying platform's API</li></ul>	<ul style="list-style-type: none"><li>✓ Access to 100% of each platform's APIs</li><li>✓ Same-day support for new APIs in OS releases</li></ul>	<ul style="list-style-type: none"><li>✓ Apps are compiled as native binaries that run just like apps built using Objective-C, Swift, and Java</li><li>✓ Apps use standard controls and platform-level support for hardware-accelerated rendering</li></ul>
Non-native	<ul style="list-style-type: none"><li>✗ Limited to a subset of APIs</li><li>✗ Limited to a subset of properties</li><li>✗ Controls simulated via HTML and CSS, or by using images</li></ul>	<ul style="list-style-type: none"><li>✗ Limited to a subset of APIs</li><li>✗ Ability to compile against a new OS version, but not use native APIs</li></ul>	<ul style="list-style-type: none"><li>✗ Apps are interpreted at runtime or through a webview</li><li>✗ Apps use non-standard UI and/or lack access to hardware acceleration</li></ul>

## Build engaging native apps with Xamarin for Visual Studio Enterprise

With Xamarin for Visual Studio Enterprise, you can use your existing skills and language to quickly build high-performance, fully native Android, iOS, and Windows apps.

### Xamarin's unique approach

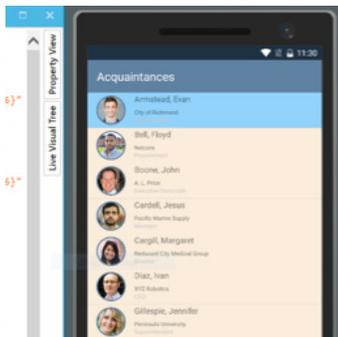


## At a glance: defining native Xamarin apps

- 1. Native UI:** Xamarin apps look native because they are native. Xamarin is the only cross-platform solution that exposes 100% of the UI capabilities of each device platform.
- 2. Native API:** Anything you can do in Objective-C, Swift, or Java, you can do in C# with Xamarin. Its unique binding technology allows C# to call the same APIs and use the same UI controls as apps built in platform-specific languages.
- 3. Native performance:** Xamarin apps are compiled as native binaries—not interpreted or executed in a web view—resulting in high-performance apps under the most demanding scenarios like complex data visualizations and high-frame-rate simulations.

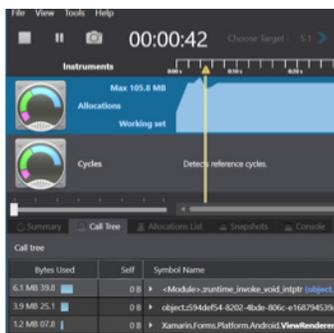
## Unique Xamarin features exclusive to Visual Studio Enterprise

With the following Xamarin features available only through Visual Studio Enterprise, you'll have the power to optimize app performance, increase security, simplify UI testing, and release higher-quality apps faster.



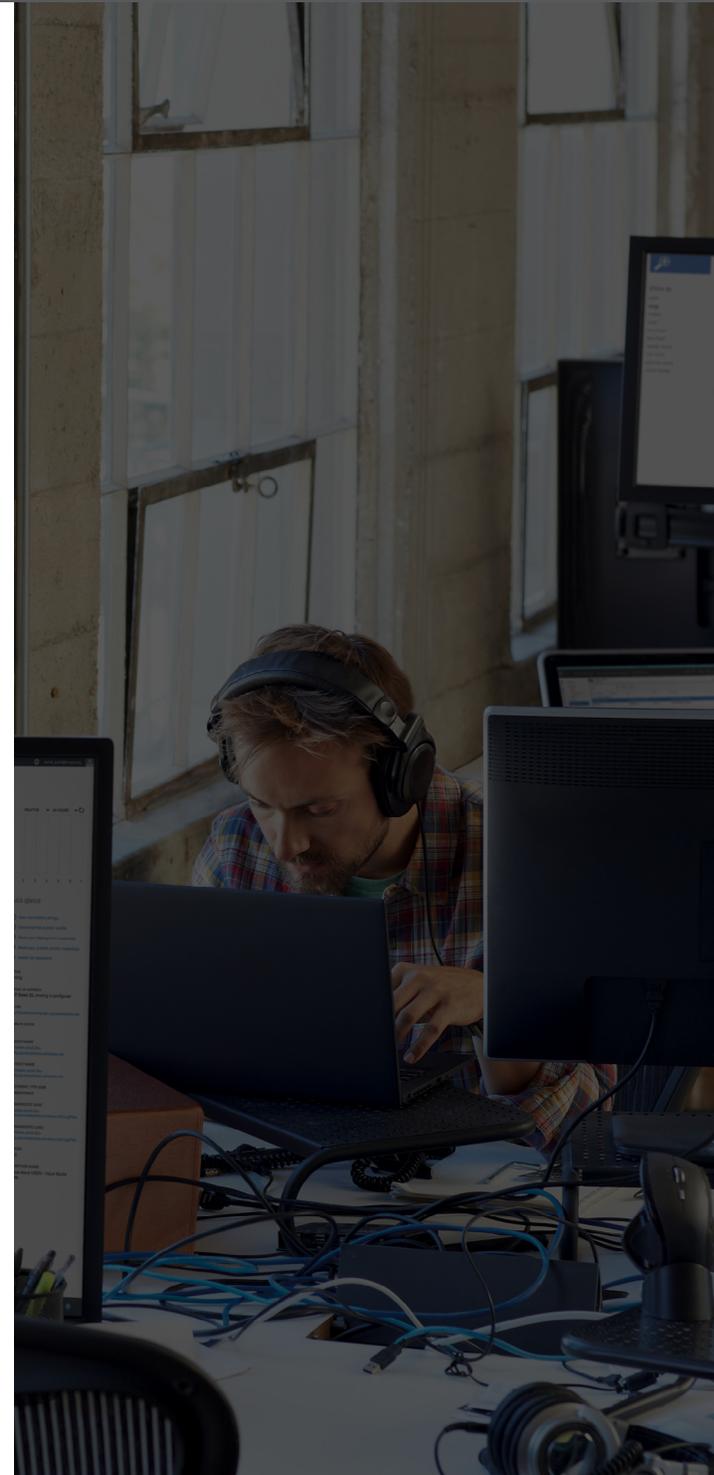
### Xamarin Inspector:

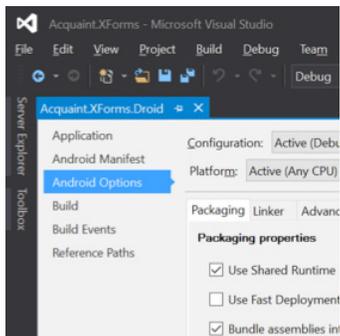
See, inspect, and interact with UI changes in real-time—no compilation required. Quickly verify that your code works as expected, and get updates to users faster.



### Xamarin Profiler:

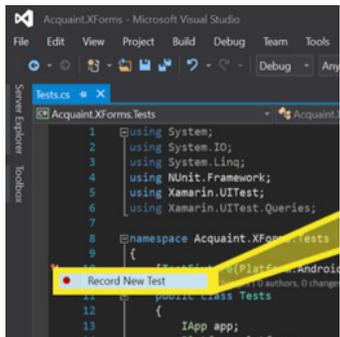
Identify memory leaks and performance problems at the code level, pinpoint the root cause, and address issues before they impact your apps' stability and battery consumption.





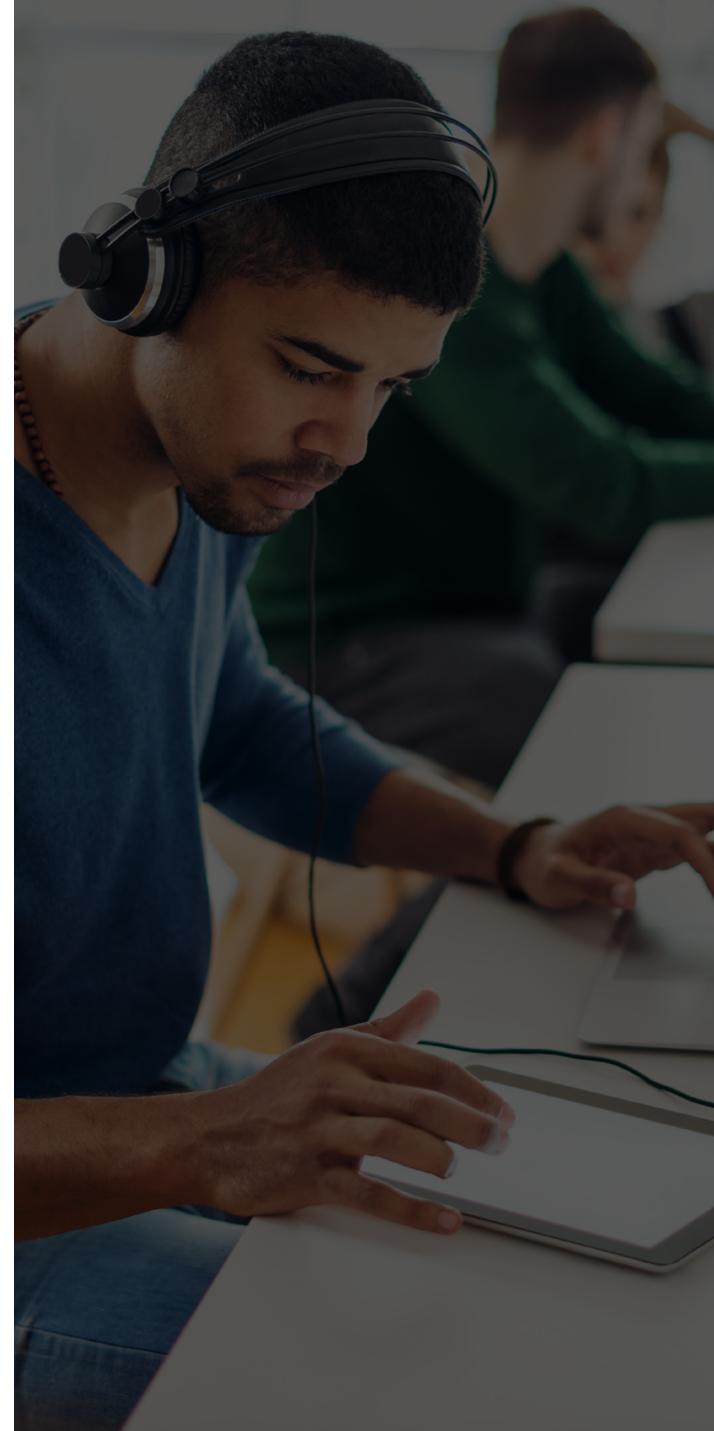
### Embedded Assemblies: additional code protection for your Android apps

Add an additional layer of protection to your Android apps. Mobile apps are more vulnerable to malicious attacks and reverse engineering than server-side apps and require multiple levels of security.



### Xamarin Test Recorder (preview):

When you manually interact with your app, Xamarin Test Recorder records your actions, plays them back, and automatically creates test scripts. Execute Xamarin Test Recorder scripts locally, or automatically on [Xamarin Test Cloud's](#) 400+ real device and operating system configurations.



## Getting started with Xamarin

Xamarin allows you to leverage Visual Studio, the power of C#, and the .NET framework to create, debug, test, and deploy native mobile apps. Explore educational how-to videos, technical documents, samples, and other resources to learn more.

### Xamarin University self-guided learning

Learn at your own pace with on-demand training videos, course materials, and labs. Courses cover all of the fundamentals, from setting up your development environment and creating your UI to accessing web services and storing local data with SQLite.

[Get started >](#)

### Xamarin Development Center

Access detailed, step-by-step technical resources from mobile experts, browse community forums to share tips or ask questions, and more.

[Visit the center >](#)

### Xamarin video tutorials

See how you can use Xamarin.iOS, Xamarin.Android, and Xamarin.Forms to create native-performance applications—from a single C# codebase:

**Native iOS, Android, & Windows Apps from C# and XAML with Xamarin.Forms**

[Watch now >](#)

**iOS & Android Development for the C# Developer with Xamarin**

[Register for webinar >](#)

### The Xamarin Show

This weekly web series features industry leaders discussing native, cross-platform mobile development, the latest Xamarin news, industry trends, and much more.

[Watch episodes >](#)



**Xamarin is the complete lifecycle solution for creating mobile apps. It allows our team to create apps... with very little learning curve. We deploy a wide variety of devices. Being able to deliver all in one is a huge benefit.**

Senior Application Architect



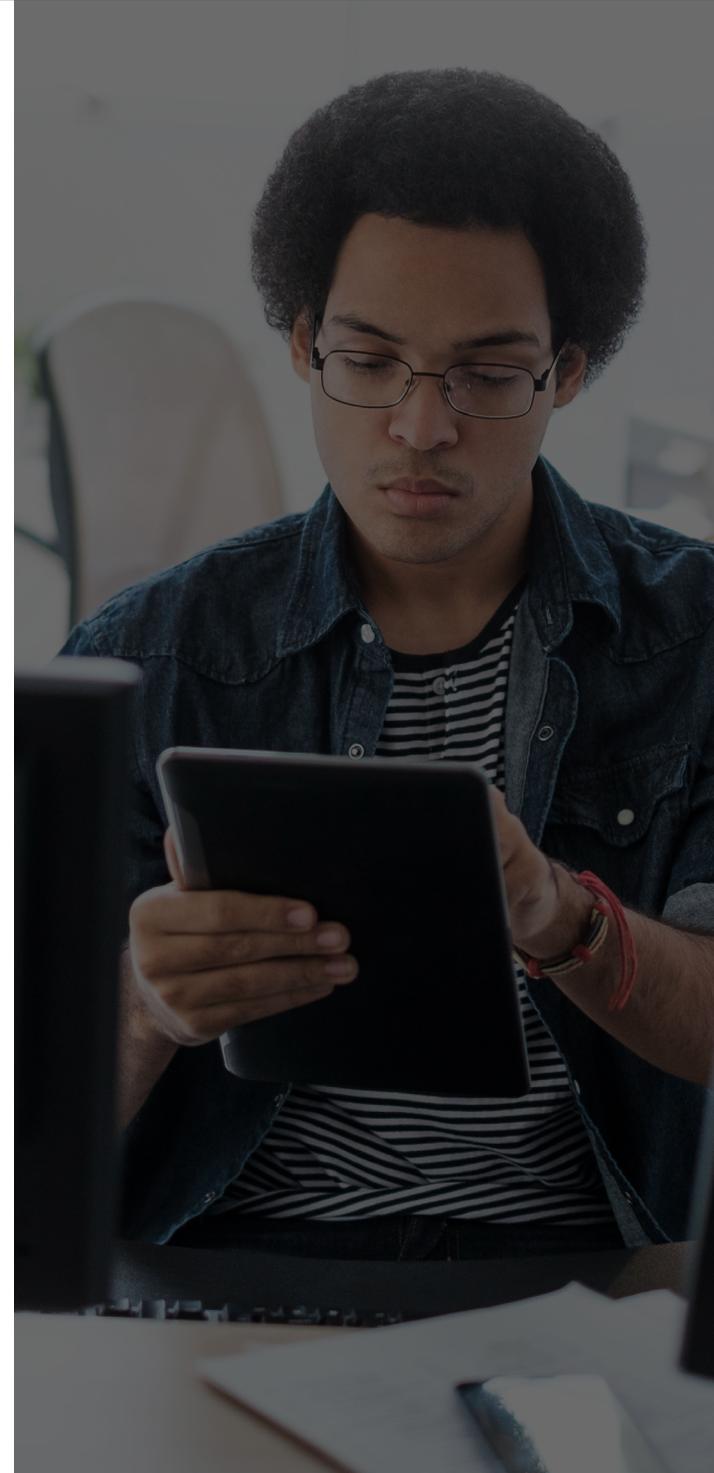
# Build hybrid mobile apps using HTML, CSS, and JavaScript

## Visual Studio Tools for Apache Cordova

Web app developers will have no problem building mobile apps for Android, iOS, and Windows using [Visual Studio Tools for Apache Cordova](#). A single shared JavaScript API provides nearly 100% code re-use across platforms as well as access to device capabilities—like the camera, calendar, and contacts—using a familiar, concise syntax.

Plus, because hybrid apps make use of native WebViews, you can take your preferred JavaScript framework with you, like Angular, React, and Ionic.

Access quick and easy code-editing features like syntax highlighting and IntelliSense. Test your app across mobile platforms using Visual Studio integration with various emulators, or run it on hundreds of devices with [Xamarin Test Cloud](#). Continuously improve your app with the CodePush plugin, which helps you get product improvements in front of your users instantly.



## Getting started with Visual Studio Tools for Apache Cordova

Start building hybrid mobile apps for Android, iOS, and Windows right away:

### Beginner's Guide

Take a tour of what you can do with Visual Studio Tools for Apache Cordova. You will also have the opportunity to build a basic app.

[Get started >](#)

### Cross-Platform Mobile with Cordova and Ionic Framework

In this video, members of the Ionic and Visual Studio teams build a demonstration app using VS Code, Visual Studio, Azure Mobile Services, Ionic, and Code Push.

[Watch the demo >](#)

## At a glance: Visual Studio Tools for Apache Cordova

- 1. Leverage existing web developer skills:**  
Use familiar web developer tools, debugging tools, and Visual Studio extensions to build mobile apps with all editions of Visual Studio 2015.
- 2. Build apps that feel native, with Ionic:**  
Paired with the [Ionic Framework](#), use web technology to build apps that look and feel like native applications.
- 3. Access device capabilities, with Cordova plugins:**  
By leveraging the thousands of [Apache Cordova plugins](#), you can access the most common device features using consistent JavaScript APIs across all devices.

# Build for the mobile web once, iterate easily

## Visual Studio and ASP.NET

With Visual Studio, you have the control and flexibility you need to create, optimize, and deploy modern web applications and websites that adapt to mobile devices.

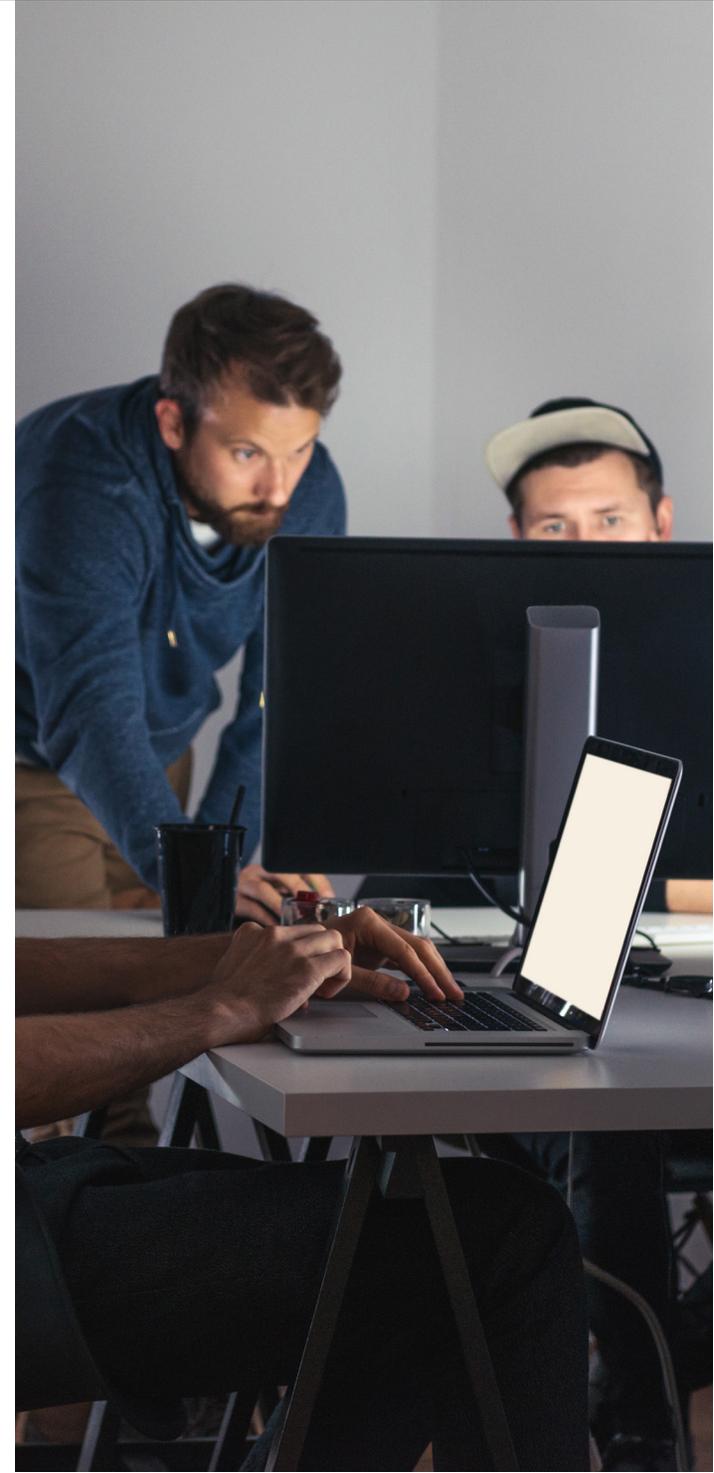
Use your preferred language to develop for the web with ASP.NET, Node.js, Python, or JavaScript, and move between languages and project types with ease using the best-in-class editor for HTML5, CSS3, and JavaScript.

Build responsive websites using Visual Studio code editor features like CSS IntelliSense and ASP.NET MVC default templates with bootstrap framework support. Create dedicated mobile pages for web scenarios requiring specific views using ASP.NET built-in mobile support. And test your website across browsers and mobile platforms using Visual Studio integration with all modern browsers and various emulators.

### Creating Apps Geared Toward Mobile First

In this Mobile Web Application Development series, you'll explore mobile design considerations, libraries to help enable touch, menuing systems, QA tools, and more.

[Watch series >](#)



# Microsoft Azure integrated cloud services

# Why the cloud backend matters

In addition to developing your mobile frontend, your mobile backend is vital to your apps' success. Now that you know what it takes to create five-star mobile apps, you need a way to connect those apps to a scalable, secure backend that has everything you need to continuously build and deliver engaging user experiences.

”

Using Microsoft Azure—whether exclusively or as part of a hybrid cloud deployment—we are able to bridge traditional infrastructure barriers while meeting the security and privacy needs of our customers around the world.

Software Chief Technology Officer

GE Healthcare

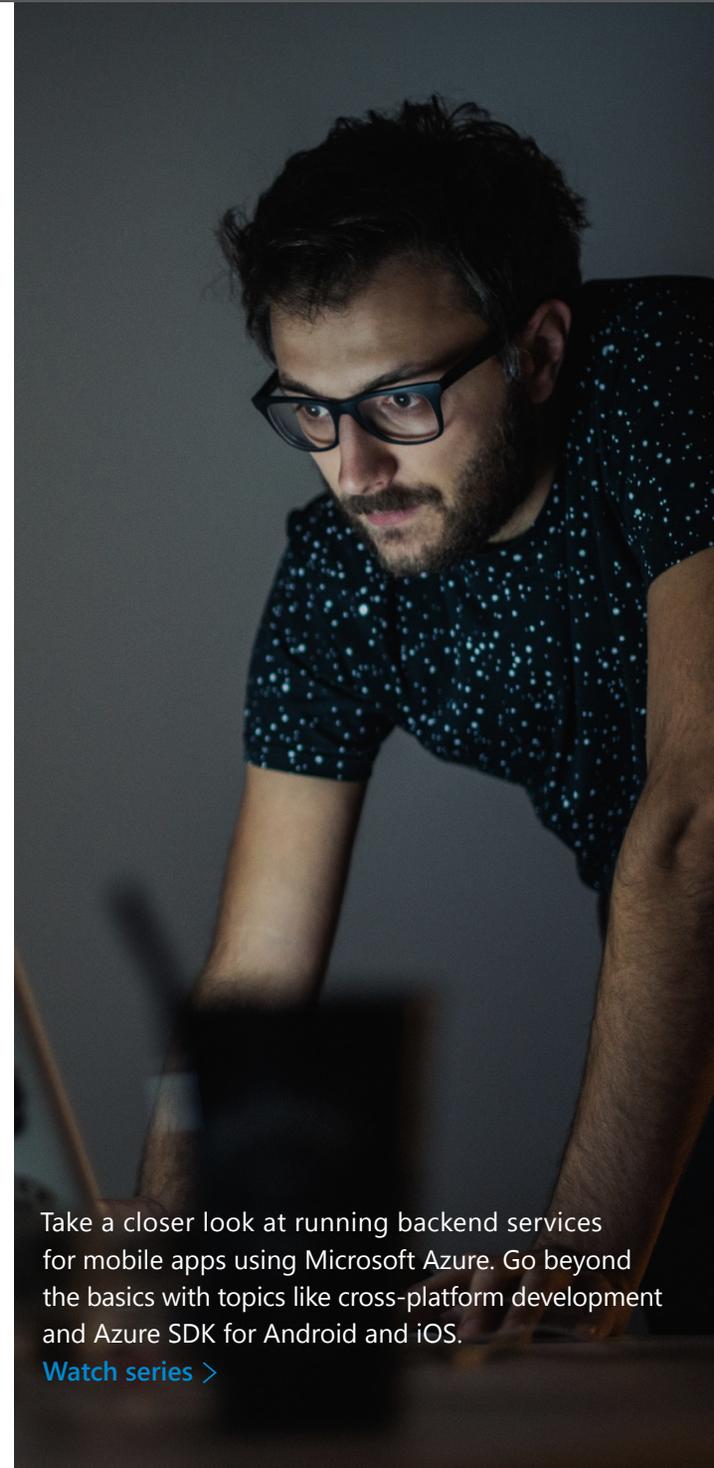
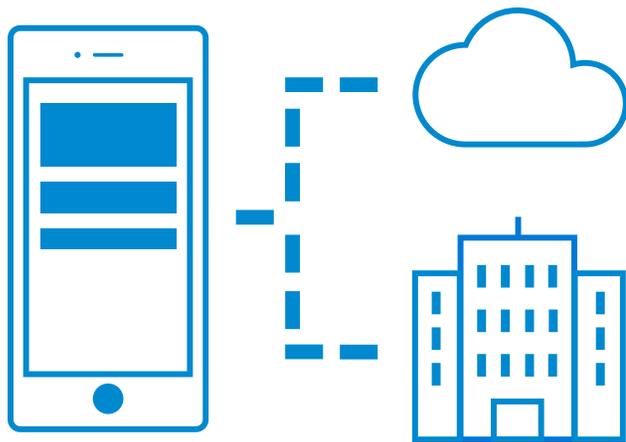


## Microsoft Azure: the cloud on your terms

Azure is a flexible cloud platform that allows you to efficiently extend your business to mobile. Connect your apps to more than 50 scalable Azure cloud services, quickly adding push notifications, offline sync, machine learning, data services, and other capabilities.

Dive into the sections below to learn how you can create amazing, cloud-powered apps with Azure:

- Azure App Service (p. 23)
- Azure data services (p. 26)
- Advanced analytics and intelligence services (p. 28)



Take a closer look at running backend services for mobile apps using Microsoft Azure. Go beyond the basics with topics like cross-platform development and Azure SDK for Android and iOS.

[Watch series >](#)

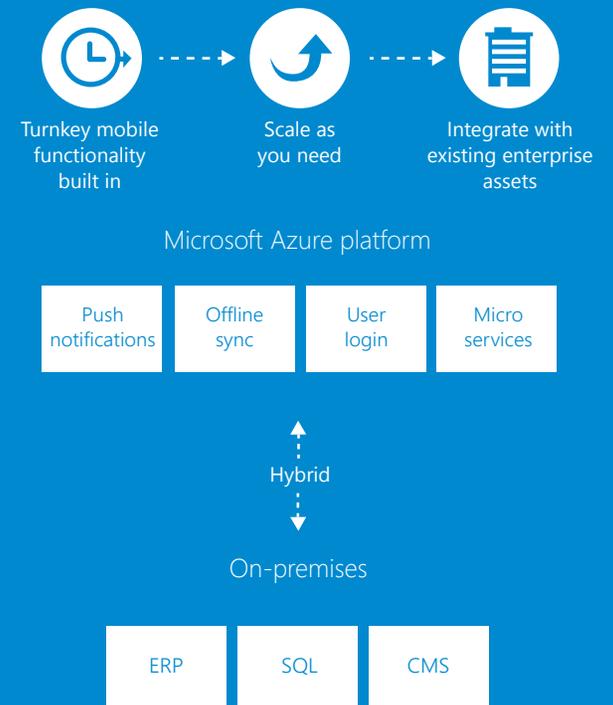
# Deploy powerful mobile apps

## Microsoft Azure App Service

The cloud backend is particularly critical to mobile app development in the enterprise. Through the use of existing SDKs and APIs, you have services at your fingertips versus needing to write custom integrations.

Azure App Service is a one-of-a kind cloud service that integrates everything you need to quickly and easily build apps for any platform or device. And with Azure Mobile Apps, a highly specialized part of Azure App Service, you can create engaging mobile apps for Android, iOS, and Windows, implementing the must-have features that are expected in a mobile app today.

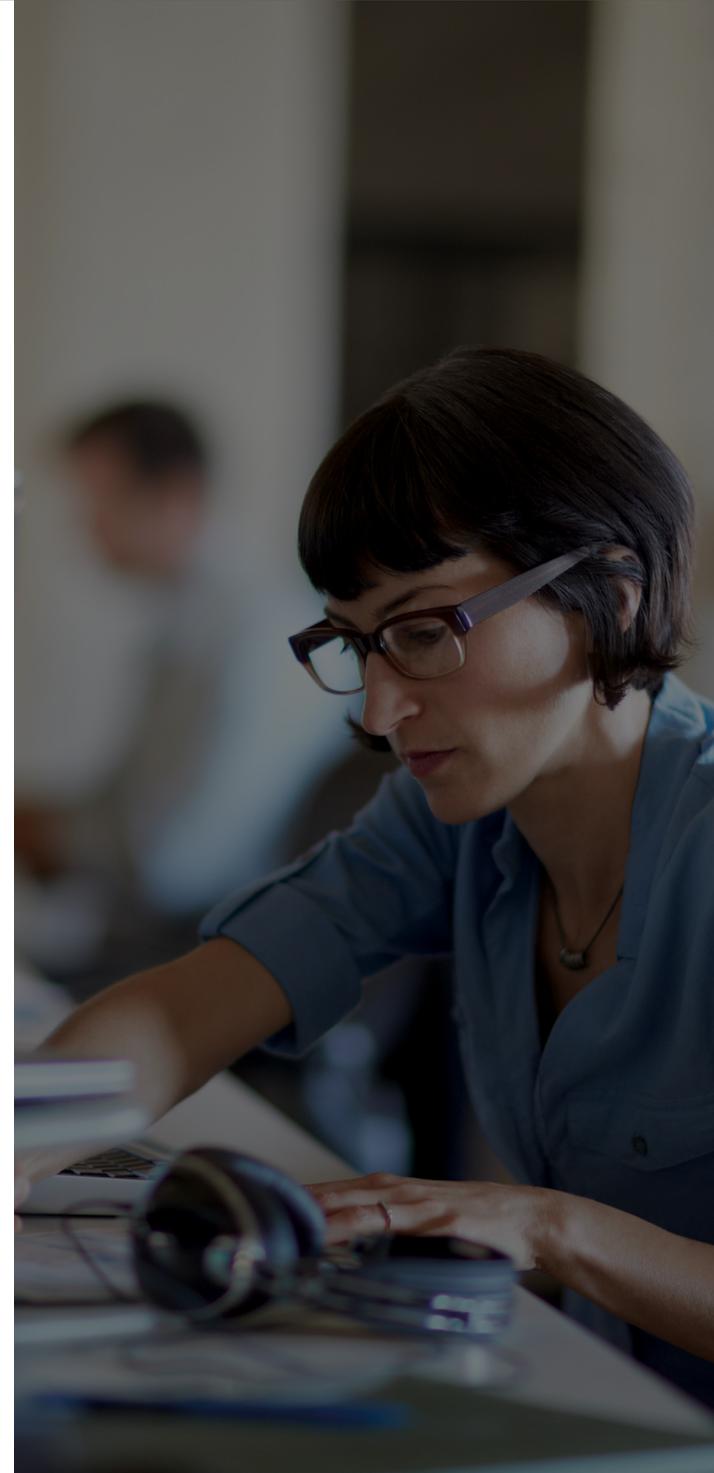
Using Azure to scale and accelerate mobile application



## Key benefits of Azure Mobile Apps

Azure Mobile Apps has everything you need to rapidly build engaging Android, iOS, and Windows apps; store app data in the cloud or on-premises; authenticate users; send push notifications; or add your own custom backend logic in C# or Node.js.

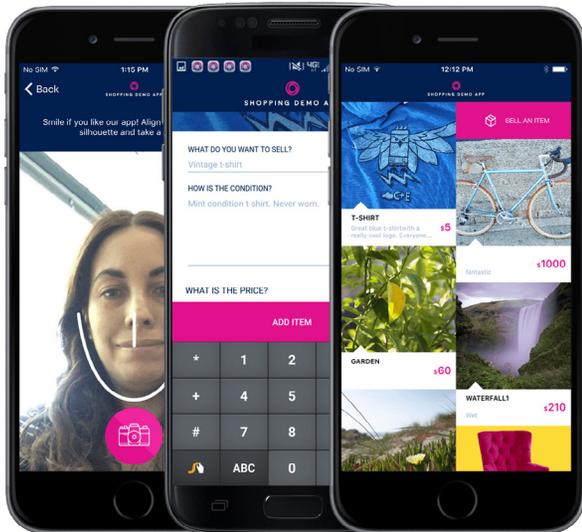
- Easily add enterprise single sign-on with Active Directory.
- Use offline data sync to create robust apps that remain useful when there are network issues.
- Connect your apps to on-premises data with Hybrid Connections and VPN.
- Broadcast personalized push notifications to millions of users in minutes.
- Autoscale to support millions of devices and reach users anywhere in the world.
- Seamlessly integrate with Facebook, Twitter, and Google.



## The power of Azure + Visual Studio Enterprise

Using Azure with Visual Studio Enterprise offerings—particularly Xamarin for Visual Studio Enterprise—makes it easier than ever to take your apps to the next level.

You get all the capabilities of Visual Studio Enterprise for building Android, iOS, and Windows mobile apps, plus all the cloud features offered through Azure App Service and Azure Mobile Apps, to create engaging apps your users will love. [This short video](#) gives you an overview of how using Azure and Xamarin can help you create cloud-powered native apps.



### Shopping Demo App

Explore our B2C eCommerce sample app to learn how you can connect Xamarin mobile apps to the cloud, and access quickstarts for Azure and Xamarin.

[Get started](#) >

[Learn more](#) about Xamarin and Azure, and discover additional sample apps.

## Experience how Azure and Visual Studio Enterprise work better together

### Developing Connected Apps Using Azure and Xamarin

This Xamarin Evolve16 session shows you how to reuse your existing .NET skills to quickly build web services into your Xamarin apps, leveraging the power of Azure App Service, to give you everything you need to build better apps.

[Watch session](#) >

### Building Cross-Platform Enterprise Mobile Apps with Visual Studio and Azure App Service

Learn how Azure App Service helps you build great connected mobile experiences, including single sign-on, push notifications, offline data sync, and connectivity to on-premises systems. Plus, see how you can use Mobile App client SDKs to build a native experience on multiple platforms.

[Start tutorial](#) >

# Flexible data services for your app backend

## Microsoft Azure data services

Azure data services provides a broad variety of data storage options that complement any application and are especially relevant for mobile apps. See how services like [Azure SQL Database](#), DocumentDB, and Azure Search allow you to manage, capture, visualize, and ultimately take intelligent actions based on ingested data.

## Azure SQL Database

Make building and maintaining applications easier and more productive. With built-in intelligence that learns app patterns and adapts to maximize performance, reliability, and data protection, SQL Database is a cloud database built for developers.

[See how you can quickly create an Azure SQL Database >](#)



**With Azure... we can focus our resources on what we do best: leveraging our expertise in procurement to write software that truly delivers results for our customers.**

VP of Technology Solutions



## DocumentDB on Azure

As a schema-free NoSQL database, DocumentDB provides rich and familiar SQL query capabilities with consistent low latencies on JSON data—ensuring that 99% of your reads are served in under 10 milliseconds and 99% of your writes are served in under 15 milliseconds. These unique benefits make DocumentDB a great fit for mobile and many other applications that need seamless scale and global replication.

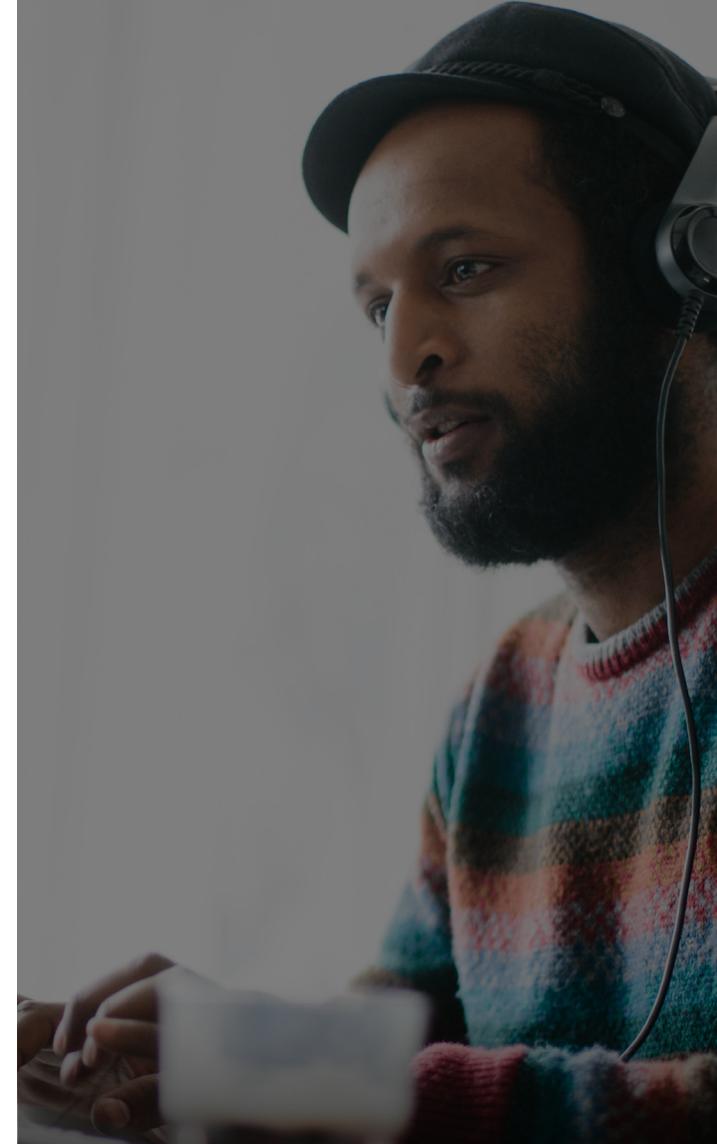
[Watch the process of creating DocumentDB on Azure >](#)

## Azure Search

When it comes to search, user expectations are high. They expect great relevance, suggestions, near-instantaneous responses, multiple languages, faceting, and more. [Azure Search](#) makes it easy to add powerful and sophisticated search capabilities to your apps.

The integrated Microsoft natural language stack, also used in Bing and Office, has been improved throughout 16 years of development. Quickly and easily tune search results, and construct rich, fine-tuned ranking models to tie search results to business goals. Reliable throughput and storage provide fast search indexing and querying to support time-sensitive search scenarios.

[Learn how to create a five-star search experience with Azure Search >](#)



Learn how to combine Azure SQL Database, DocumentDB, and Azure Search to ingest stored documents, social data, and structured transaction data to build apps with different data needs.

[Start course >](#)

# Preparing for the next generation of apps

## Microsoft Azure advanced analytics and intelligence services

The power of data and artificial intelligence are changing the way we build and design mobile experiences. Azure has you covered, with services that let you: build apps with powerful artificial intelligence algorithms; enhance your apps with machine intelligence to evolve from descriptive to prescriptive analytics; embed stunning, interactive data visualizations into your apps; and easily store, manage, and get the most out of your data.

## Microsoft Cognitive Services

With **Cognitive Services**, you can build “smart” into your apps across Android, iOS, and Windows. Tap into an ever-growing collection of artificial intelligence algorithms for vision, speech, language, and knowledge.



As part of its mission to empower every person and every organization on the planet to achieve more, Microsoft is creating and delivering technology for people of all abilities. The Cognitive Services project “Seeing AI” is an example of this. In partnership with Pivothead, Microsoft is using intelligent APIs like computer vision, image and speech recognition, natural language processing, and machine learning to help the visually impaired.

[Learn more about the “Seeing AI” project >](#)

## Azure Machine Learning

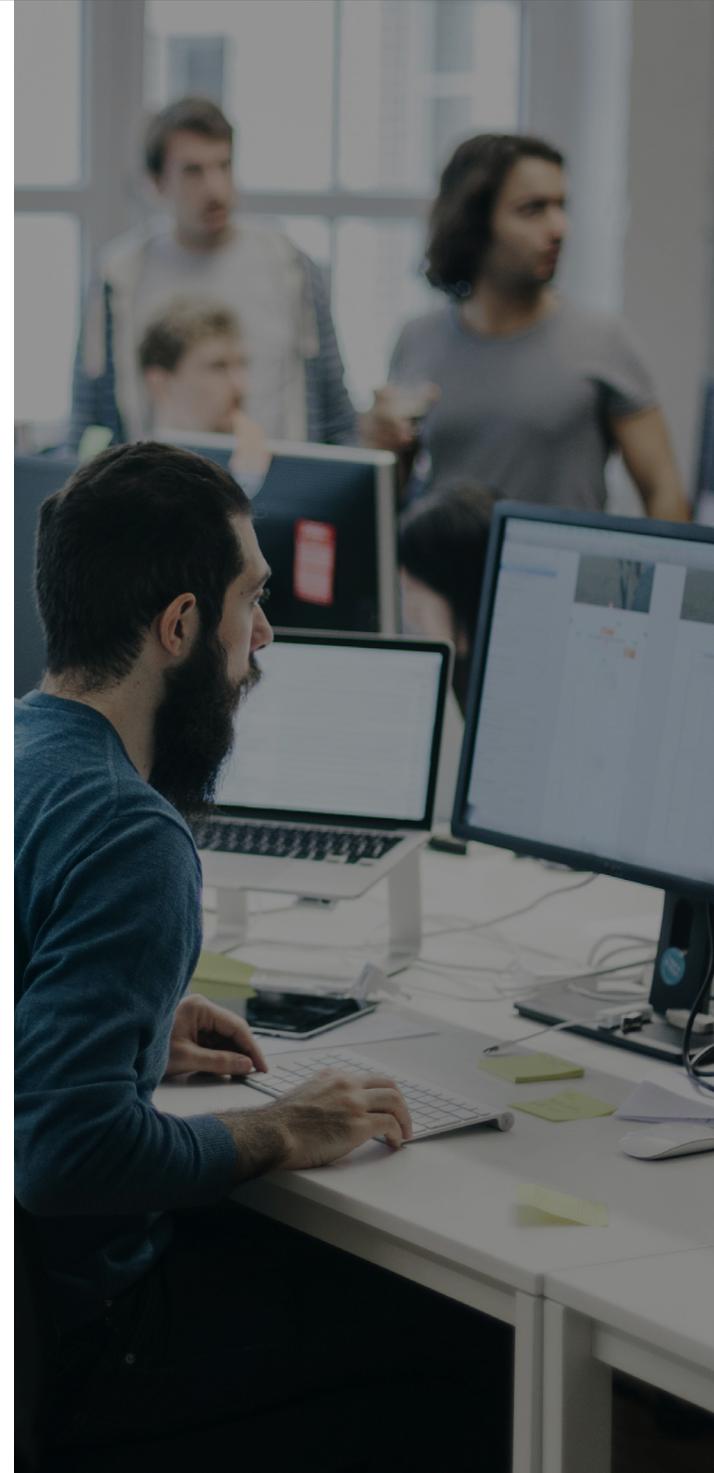
**Azure Machine Learning** is a powerful, fully managed cloud service that enables you to quickly and easily build, deploy, and share predictive analytics solutions.

[Watch “Machine Learning for Muggles” for an overview >](#)

## Azure Power BI Embedded

Power BI Embedded lets you create compelling interactive reports without writing any code, embed visuals in your app with no design required, and deploy quickly at cloud scale while managing costs.

[See how you can give your apps a boost with Power BI Embedded >](#)



## Azure Data Lake and HDInsight

With Azure Data Lake, you have all the capabilities required to easily store data of any size, shape, and speed, as well as accomplish a variety of processing and analytics across platforms and languages. With HDInsight—a managed Apache Hadoop, Spark, R, HBase, and Storm cloud service made easy—you'll be better equipped to crunch all data, scaling on demand, and spin up any number of nodes at any time.

[Watch this short video for an overview of Data Lake >](#)

## Ready to make your apps smarter?

### Intelligent Data-Driven Applications that Learn and Adapt

Learn how to introduce useful data-driven intelligence into your apps in order to spot trends, react to unusual events, predict outcomes, and more.

[Watch video >](#)

### Intelligence Apps Leadership Panel

Gain insights from Microsoft senior leaders and experts in data, machine learning, and analytics as they discuss adding intelligence into existing and new apps.

[Watch discussion >](#)



**The Microsoft Azure platform makes it a lot easier for us to deliver on our vision without getting stuck on the individual IT components. We can focus on our end solution and delivering real value to customers rather than on managing the infrastructure.**

Senior Enterprise Architect Data Services



**Rolls-Royce**

# Get started today with Visual Studio Enterprise

Whether you're building your first app or looking to scale dozens of internal apps, you can create amazing mobile experiences using the language and skills you love with Visual Studio Enterprise. And no matter which mobile development approach you use, Visual Studio Enterprise has options to support your choice.

Xamarin for Visual Studio Enterprise has everything you need to develop rich, native Android, iOS, and Windows apps faster than ever.

As you start building your apps with Visual Studio Enterprise, connect them to the Microsoft Azure cloud platform, offering essential mobile services like push notifications, user authentication, and more.

Continue to refer back to this guide to access the valuable resources available for Visual Studio Enterprise, Xamarin, and Azure.

[Download your free trial of Visual Studio Enterprise >](#)

## Sources

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4. **Gartner**, "IT Leaders Should Drive to Perfect the Customer Experience Through Mobile Apps," July 7, 2015, <https://www.gartner.com/doc/3089019/it-leaders-drive-perfect-customer>.