

Developing Progressive Web Apps

A #ThinkBeyond Best Practice Series

PHOTON®

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Executive summary

Mobile devices can be deemed as one of the most important technological accomplishments of the 21st century. Mobile applications have revolutionized how businesses attract, engage, and retain consumers. There is an app out there for every activity a connected consumer indulges in.

The proliferation of mobile devices, the ubiquity of the Internet, and the abundance of third-party mobile apps have created a mobile ecosystem for businesses to thrive upon. The rise of Progressive Web Apps (PWAs) is changing the dynamics of this rapidly evolving ecosystem. The prominence and popularity of PWAs are growing rapidly owing to their unique functionality of getting seamlessly integrated with web browsers while delivering native app-like features, thereby giving businesses the capability to reach more consumers and deliver highly engaging experiences without the need to drive app installs.

This guide discusses PWAs and how they boost an organization's app strategy by leveraging APIs and modern web browsers. It answers the most pressing questions about this emerging technology and explains in detail the tools and technologies required to build PWAs or extend your current app architecture to support PWAs. The guide discusses Photon's best practices and roadmap to build best-in-class PWAs. It further reveals how Photon helps Fortune 100 companies build successful PWAs to transform customer experience and drive engagement.

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Overview

Mobile apps are evolving rapidly with advancements in app development and distribution strategies. Progressive Web Apps can be seen as an evolved version of native mobile apps. By combining a web browser with the best features of native apps, PWAs give a business the opportunity to take the user experience to the next level. PWAs leverage APIs and modern web browsers to create the look and feel of a native app with low development costs, helping companies improve performance and create immersive experiences to better engage consumers and improve loyalty.

Tech giants such as Google, Apple, and Facebook have shown tremendous support for PWAs. Google is focused on utilizing PWAs for improving its web search as well as native app experience. PWAs contain all the important qualitative parameters—such as usable metadata, fast loading times, and minimum data usage—which allow Google to rank websites. They have the ability to deliver an experience identical to using a mobile app only through a web browser without the hassle of downloading from a store to install it. This makes PWAs a perfect fit for Google's efforts to bridge the gap between the web and mobile experience.



Pre-iPhone era

- Online shopping became a reality with public Internet in 1991. Amazon, eBay, Zappos, and Etsy were some of the first eCommerce sites
- eCommerce soon shifted to mobile devices. The first shopping experiences were limited to payments or phone banking services through text messages
- The early 2000s saw the proliferation of PDAs, cellular phones, and WAP-enabled smartphones, paving the way for mCommerce. Although widely available and accessible, it still had security vulnerabilities and congestion problems
- Between 2005 and 2010, with the Internet's reach, mobile phones overtook household PCs as the most common tool for web use globally

The app era

- In July 2008, Apple's App Store was launched with 500 mobile apps. Google soon followed with the launch of the Android market in 2008
- The number of app downloads increased 1100% from 2010 to 2012, tracking at over 90 billion downloads across Android and iOS stores
- Customers started to spend over 90% of their on-screen time on mobile applications; with 'shopping' being the fastest growing mobile app category
- Mobile applications provided greater engagement with personalized content and a fluid UX along with deeper analytics, multi-layered security, and improved conversions

Mobile responsive web

- In 2012, 10.9% of all website traffic worldwide was generated through mobile phones, making mobile optimization a core component
- Google updated its algorithm to prioritize sites that display well on smartphones
- PC sales dropped drastically due to the shift to mobile
- In 2013, Adaptive Responsive Design (ARD) enabled front-end applications to fit any form factor using a single code-based platform

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AMPs & PWAs

Accelerated Mobile Pages

- The Accelerated Mobile Pages (AMP) is an open-source platform created on JavaScript that allows for faster page-loading than regular HTML
- A method to build web pages for static content that makes it easier for publishers to create fast, mobile-friendly content
- Originally introduced to compete with Facebook's Instant Articles, it is now found scattered across organic search results
- AMP increases speed greatly by reducing the need for additional CSS requests and eliminating bulky pictures and CTAs in some cases
- AMP prioritizes efficiency over UX elements of the webpage

PWAs

- The term "Progressive Web Apps" is coined by Alex Russell and Francis Berriman from Google
- The rise of "mobile-first" prompts businesses to experiment with PWAs
- Microsoft and Apple focus on PWAs for maximum discoverability

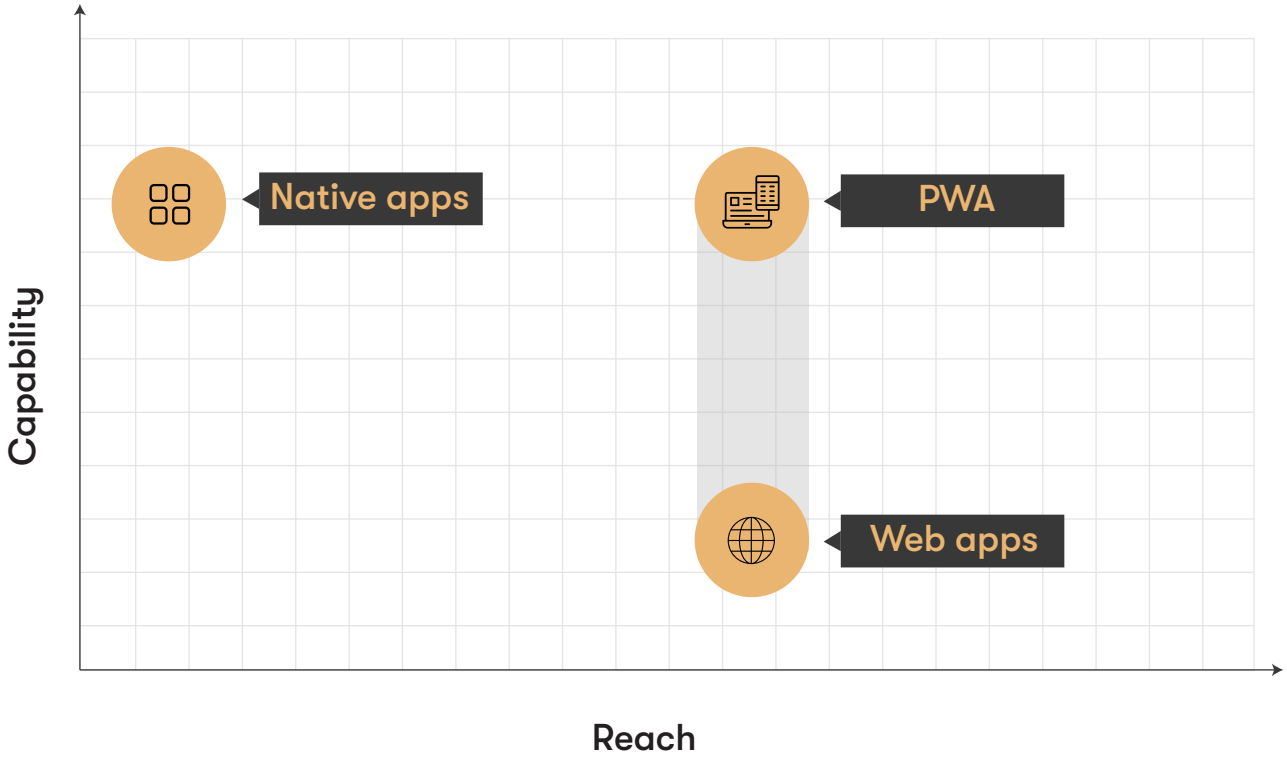


What are **Progressive Web Apps?**

PWAs are cross-platform software applications that leverage modern web technologies to deliver mobile app-like features and user experiences through a web browser. The term “Progressive Web Apps” was coined by Alex Russell and Francis Berriman from Google in 2015. In Alex’s words, “Progressive Web Apps are just websites that took all the right vitamins.”

The reasons why consumers prefer native mobile apps are that they are fast and reliable, they have features like push, sync, and sensors, and can be integrated with the phone’s hardware, like the camera or mic, when required. Research suggests that an average person spends 90% of their mobile time on mobile apps versus the mobile web[1].

The flip side to native apps is that their usage is highly concentrated. Users spend 77% of their time on their top three apps[2]. They see apps as a big commitment to space, time, and cost. And while web apps do not have all native features, they are more user-friendly and provide better privacy. Another crucial area where web apps create value is reach, as they are far more discoverable. PWAs deliver the best of both worlds as they combine the native features of a mobile app and the reach of a web app.



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"Progressive Web Apps are at the forefront of application development strategies. We are excited to see if this cracks the code on the issue of app downloads."



Mukund Balasubramanian,
CTO, Co-Founder,
Photon

Characteristics of PWAs

PWAs have a variety of key features and characteristics that make them different from a native or hybrid mobile app. These features focus primarily on improving performance, efficiency, and user experience.



Discoverable

When compared with native apps, PWAs have better representation on search engines as they are SEO-friendly and, therefore, more discoverable. They have usable metadata that helps search engines catalog, index, and rank them, and techniques like server-side rendering provide them the right architecture for top SEO rankings.



Installable

One of the most important features of the native app experience is the presence of launchable home screen icons. PWAs provide the users this native app-like experience via a feature available in modern smartphone browsers called 'Add to Home Screen.'



Linkable

A PWA can be shared by a specific link (URL), enabling ease of access to the application. Unlike a native mobile app, there is no elaborate installation process or the need for an App Store.



Network independent

PWAs allow users to use modern web apps independent of the network connection. Under unreliable or even non-existent networks, PWAs give users the ability to revisit a site and browse previously visited content. Service providers can control what the user sees in situations where there is no connectivity.

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Progressive

The progressive enhancement makes PWAs stand apart from native mobile apps. It ensures that web apps have a cross-platform functionality to seamlessly work with every browser type available.



Re-engageable

With technologies like service workers for controlling pages, Web Push API for updates, and Notifications API for system notifications, PWAs can re-engage users with the latest updates and new content like a native mobile app.



Responsive

The responsive design of PWAs ensures that the UI design meets the requirements of the device being used. Technologies like media queries and viewport help them fit any form factor—desktop, mobile, tablet, etc.

Companies are increasingly focusing on the development of PWAs to improve customer acquisition and retention. Flipkart, India's largest eCommerce site, built a PWA that combines the best of the web and its native mobile app. It leverages new, open web APIs to offer a mobile web experience that loads fast, consumes less data, and re-engages users in various ways. The company achieved the following results:

- 70% increase in customer conversion with the Add to Home Screen feature
- 3X increase in time spent on site
- 40% higher re-engagement rate

Similarly, Alibaba.com, the world's largest B2B trading platform, invested in a cross-platform PWA to deliver an engaging experience on mobile. The company witnessed:

- 70% higher conversions across browsers
- 30% more monthly active users (Android)
- 4X higher interaction rate from the Add to Home Screen feature

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PWAs: **Specific questions to be answered**

PWAs are a fairly new technological development to hit the mobile ecosystem. Businesses are still experimenting with PWAs and have a lot of unanswered questions. Below we have compiled a list of the most common questions asked about PWAs and their answers.

OS support: iOS vs. Android?		
CRITERION		
VERSION	VER 4.4+	VER 11.2+
PWA	✓	✓
STORAGE LIMIT	MORE THAN 50 MB	LIMITED TO 50 MB
SERVICE WORKER	✓	✓
WEB PUSH NOTIFICATIONS	✓	✗
BACKGROUND SYNC	✓	✗
APP LAUNCHING SCREEN	✓	✓
BLUETOOTH	✓	✗
BEACONS	✓	✗
GEOLOCATION	✓	✓
GEOFENCING	✗	✗
IMAGE CAPTURE	✓	✓
VIDEO CAPTURE	✓	✓
BIOMETRICS	✓	✗
AUGMENTED REALITY	✓	✗
WEB SHARING	✓	✗

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What kind of users use PWAs?

Businesses that are targeting markets, especially in developing countries, should focus on PWAs. In various African or Asian countries, Internet connectivity is limited, and the amount of data usage is very important. Jumia Travel, a hotel reservation platform for the markets of the African continent, leveraged PWAs to reduce data usage by 5X, increase conversion by 33%, and reduce bounce rates by 50%.

What kind of brands should adopt PWAs?

Predominantly, eCommerce and CPG brands that need the ability to launch several microsites for their different brands and show up during search while being easy to install should adopt PWAs.

Is a PWA a completely new channel or a replacement channel?

Based on market maturity, PWAs should be seen as a new channel and not a replacement channel. PWAs' future potential should not be overlooked. Our recommendation is to start building dedicated new functionalities with PWAs. And as the market matures, create a single code base for all channels and migrate the features gradually.

What conversion benefits can we forecast: compared with the app, compared with a mobile web?

While a PWA is SEO-friendly, conversion benefits and brand loyalty via a native app are still much higher than a PWA (by over 26%). A PWA serves as the right channel for acquiring new customers who can then slowly migrate to become native app users once the company has built brand loyalty.

What are some additional capabilities that can be leveraged?

- Home Screen
- Offline Sync
- Notifications
- Web Payment

PWAs for consumer-facing apps vs. associate facing apps?

Due to their offline support, PWAs have great potential for associate-facing apps where there are network irregularities. Device and browser support should be assessed before beginning development. PWAs for consumer-facing apps should be considered for new functionality that has potential SEO advantage with the aim to acquire new customers.

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Tools and technologies:
An architectural perspective

In this section, we discuss the tools, technologies, and architectural frameworks required to build successful PWAs.

Web App manifest

The Web App manifest—a JSON file—is the first component that gives a PWA its native app interface appearance. With the manifest, a developer can control the way the app is displayed to the user (i.e., full-screen mode without a visible URL bar) and how it can be launched.

Service workers

A service worker is a script that your browser runs in the background, separate from a web page, opening the door to features that do not need a web page or user interaction. Push notifications and background sync are some of the features that they already demonstrate.

Application shell

An application shell (or App Shell) is a collection of local resources that a web app needs while loading the skeleton of the user interface. For SPAs with JavaScript-heavy architectures, it is the go-to approach. PWAs use a service worker to cache the app shell and data content so that it always loads fast even when fully offline, retrieving from the cache and making live calls when needed.

Server-side rendering

- The server returns a complete page
- Page loads CSS, JavaScript, and all content
- Page updates reload the DOM

Client-side rendering

- Server returns "template page" with CSS & JavaScript
- JavaScript makes a request to get content, adds to the page
- Page updates reload only the dynamic content

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Extending an app architecture to support a PWA

When companies contemplate investment in PWAs, they do not have to start from scratch. Web apps are framework-agnostic and, in all probability, any organization experimenting with PWAs will already have an app shell for an extension. They help businesses extend an existing app architecture to support a PWA. Here's how:

Extend

- App shell framework can be extended to include service worker framework
- Seamless fallback to the device that does not support PWA
- Build process can be tweaked to generate manifest - home icon, deep linking, splash screen
- Dynamic microsite specific manifest and service worker resync
- Enable offline and push notification capability across a microsite
- SEO/BOT support leveraging the existing architecture
- Middleware to support offline API replay
- Side-by-side support for PWA and non-PWA app development ecosystem
- Enhance analytics and logging framework to support offline browse experience

Reusability

- Leveraging server-side rendering and client-side rendering
- Using State Management framework
- Benefiting from common components
- Implementing the config mechanism
- Leveraging analytics mechanism

Recommended patterns in the order

- An Application shell (App Shell) + content for the entry page. Leverage JavaScript to distribute content for further routes and do a "take over"
- Application shell + use JavaScript to fetch content once the app shell is loaded
- Server-side rendering full page (full page caching)
- Client-side rendering full page (full page caching, the potential for JSON payload bootstrapping via server)

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Photon's best practices to **build a best-in-class PWA**

Assessment design, architecture blueprint and success metrics	**Timeline: 8-10 weeks**

- An overall vision and future roadmap for the PWA architectural framework is created through the analysis of the current channel touchpoints, constraints, and target state
- Scope should be prioritized based on business and organizational outcomes
- Clear objectives laid out for the PWA platform and the goals that have to be achieved
- Target state architecture definition
- Phased implementation approach defined with a detailed program plan and cost estimates
- Responsibility Matrix defined for the roles and responsibilities
- ROI and business justification for the overall program

One-time implementation	**Timeline: 3-4 months**

- Integrate appropriate PWA framework based on industry practice
- Tweak CI/CD framework to support PWA
- Framework and component enhancement to support PWA architecture and scenarios
- Update devtools and starter kit to support PWA
- Establish a push notification framework
- Coupon page with offline feature, push notification, and caching
- Measure KPA and fix and iterate
- Factory style migration of other microsites

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Ongoing sustenance	Timeline: Recurring 2-3 months

- Migrate new features to the new PWA framework
- Keeping up with updating framework with the OS upgrades
- Incorporating new OS release features into the toolkit

"PWAs apply the principle of progressive enhancement to allow every user to access the core functionality of the web page with the ability to show enhanced features for users with greater bandwidth."



Jim Kim,
VP, Executive Creative Director,
Photon



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How Photon helps **Fortune 100 firms build feature-rich PWAs**

Below are some instances wherein Photon helped Fortune 100 companies leverage its best practices to create feature-rich, highly engaging PWAs.



Client:

A Fortune 100 manufacturer of confectionery, pet food, and other food products

Requirement:

The company was looking to build a PWA that would provide digital sales assistance for in-store purchases. The envisioned application was to increase awareness and provide convenience to consumers.

Photon's involvement:

Photon was involved in the development of the PWA, which would offer capabilities like accessing catalog online, order personalization, pay online, and ship orders to location. This engagement was fulfilled in two tracks. Track 1 comprised of enhancements in configurator identified as backlog items during creative discovery, and Track 2 comprised of PWA for in-store experience. Powered by a modular architecture, Photon was able to leverage a Plug & Play framework to tailor for brand and market needs.

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Client:

A Fortune 100 US-based pharmacy store chain

Requirement:

The company wanted to develop a PWA that the store team members could use to show their customers various app features, such as Refill from Account, without revealing any protected health information. Store team members needed a hands-on experience on the app before they could demonstrate the app to customers confidently.

Photon's involvement:

Photon was responsible for developing a PWA and enabling the team members to practice running through key pharmacy flows without exposing any sensitive data. The UX was optimized for usability, app navigation, rich user interface, and an easy browsing experience while demonstrating the application to customers. Photon helped in the development of new features that could be updated remotely and instantly without the need to update any apps on the device.

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Conclusion

Connected consumers today demand consistent, immersive, and engaging experiences both on native apps and mobile websites. PWAs fulfill this need by helping businesses leverage advanced web technology to engage with consumers with a user experience similar to that afforded by a native mobile app.

Photon builds new capabilities and standards of digital experiences through a powerful network of business partners and our experienced engineers and designers. Our mobile or web app development strategies have helped Fortune 100 companies better engage with consumers and improve loyalty. From FinServ to retailers, and CPG brands to healthcare providers, Photon implements best practices on app development to meet specific business requirements and deliver next-gen consumer experiences.

Connect to Photon to build best-in-class, feature-rich PWAs that deliver value and foster growth.

References

[1]https://www.mobiloud.com/blog/mobile-apps-vs-the-mobile-web/

[2]https://www.statista.com/chart/3835/top-10-app-usage/

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