Testing Mobile vs. Web App Performance Under Varying Network Conditions

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Presenter Resume

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Abstract

This study evaluates the performance of mobile and web applications under varying network conditions (3G, 4G, Wi-Fi) using Amazon as a test case. Results show mobile apps perform 74% faster on 3G networks with consistent responsiveness, while web apps consume more memory (384–532 MB). The findings highlight the need for mobile-first, network-aware optimization strategies.

1. Research Aim & Objectives

Aim:

1. Primary Goal: To empirically compare the performance of mobile and web applications under different network conditions—specifically 3G, 4G, and Wi-Fi.
2. Focus Metrics: Load time, responsiveness (tap delay), data usage, and memory consumption.
3. Platform Used: Amazon's mobile and web interfaces were selected as representative, high-traffic, and well-optimized platforms.

Objectives :

1. Simulate network conditions (3G, 4G, Wi-Fi).
2. Measure responsiveness, load times, and memory consumption.
3. Analyze performance variations across platforms.
4. Provide optimization recommendations.

2. Research Methodology

Experimental Design: Controlled lab-based testing using standardized devices and network simulation tools

Test Scenarios	Applications Tested	Performance Metrics	Tools & Environment	Data Collection & Analysis
• Network types: 3G, 4G, 5G, Wi-Fi. • Conditions: High latency, packet loss, and bandwidth throttling.	• Mobile App (native Android/iOS) • Web App (responsive browser-based)	• Load time • Responsiveness • Data consumption • Error rates.	• Network simulation: [e.g., Charles Proxy, NetEm] • Monitoring: [e.g., Lighthouse, Android Profiler, Webpage Test] • Devices: Standardized smartphones and laptops	• Repeated trials for statistical validity • Comparative analysis using descriptive and inferential statistics.

3. Evaluation of Results

1. **Load Time Comparison** – How quickly the application or website loads across different scenarios and devices.
2. **Responsiveness (Tap Delay)** – Measures how quickly the system responds to user interactions.
3. **Memory Consumption** – Amount of memory used during operation, indicating efficiency.
4. **Total Blocking Time (TBT)** – Duration where the main thread is blocked, affecting performance.
5. **User Experience Insights** – Observations from actual users or usability tests.
6. **Strategic Insights** – Recommendations and actionable takeaways based on the analysis.

3.1 Load Time Comparison

- Mobile apps were **74% faster than web apps on 3G** (32.9s vs. 2.1 minutes).
- On Wi-Fi, web apps took **70% longer to load** than mobile apps (2.88s vs. 1.69s).

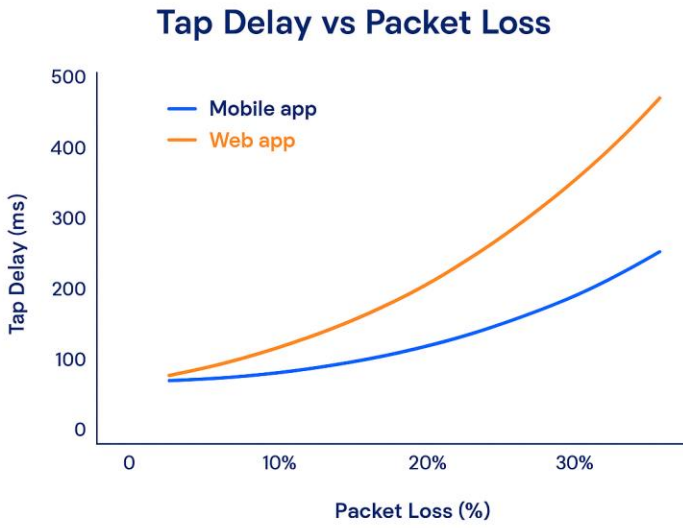
Takeaway: Mobile apps consistently outperform web apps in slow and fast networks.

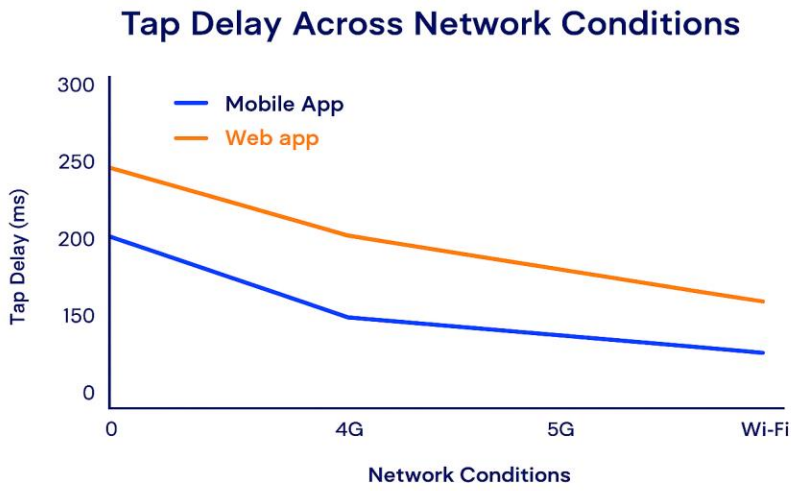
Platform	Network	Load Time (ms)	Delay Time (ms)	Data Used (MB)	Blocking Time (ms)
Mobile App	3G	3291	64.2	263	281
Web App	3G	1825	138.8	532	231
Mobile App	4G	1840	120	131	2982
Web App	4G	2050	160.3	437	155
Mobile App	Wi-Fi	1690	63	311	620
Web App	Wi-Fi	2880	163.2	384	130

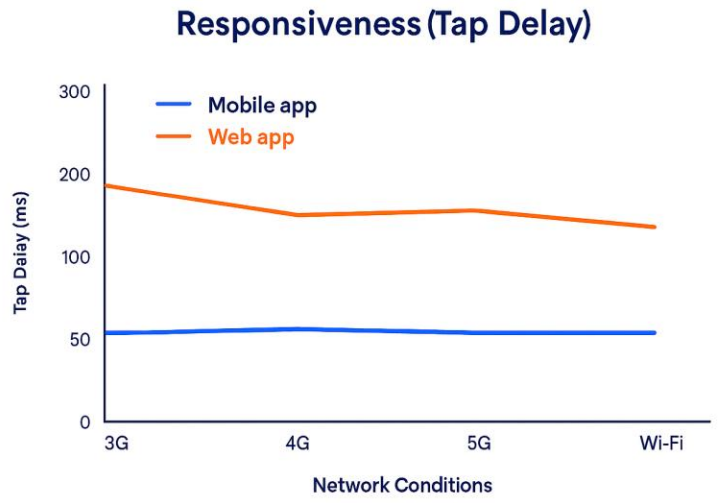
3.2 Responsiveness (Tap Delay)

- Mobile apps: **63–120ms** (stable across networks).
- Web apps: **138–163ms** (more variable, slower responsiveness).

Takeaway: Mobile provides a smoother user experience with less interaction delay.



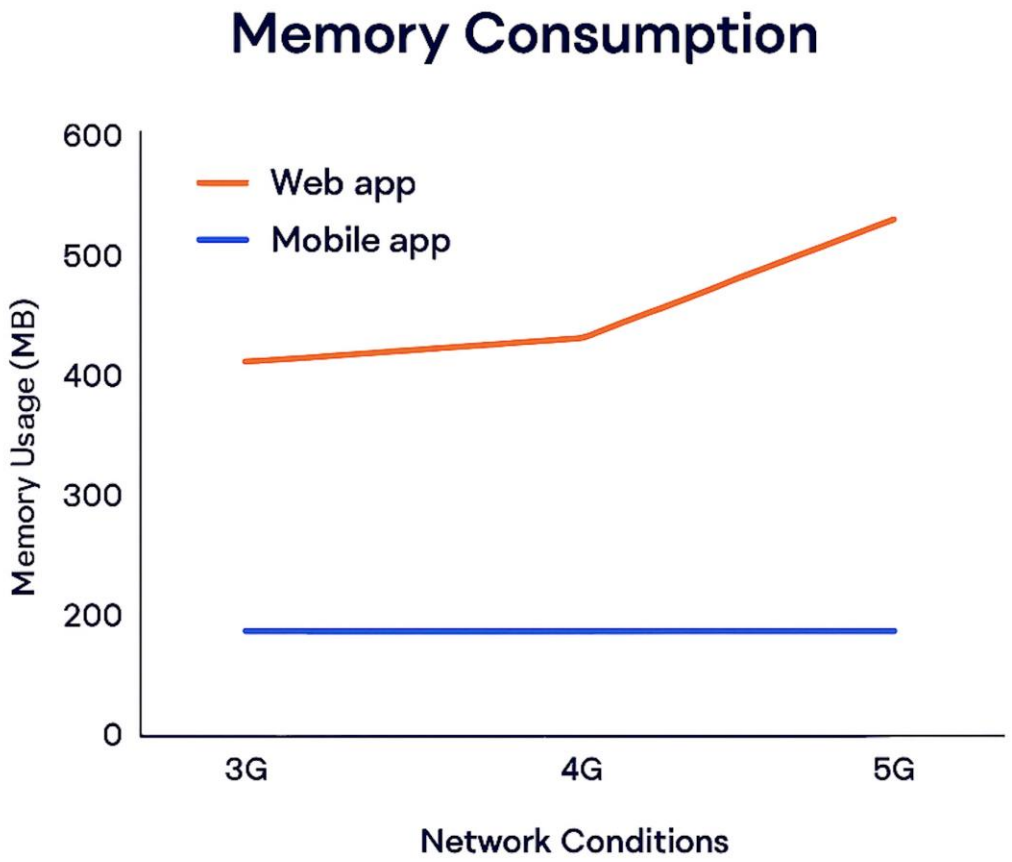




3.3 Memory Consumption

- Web apps: **384–532MB** (high usage).
- Mobile apps: **131–311MB** (lower and more efficient).

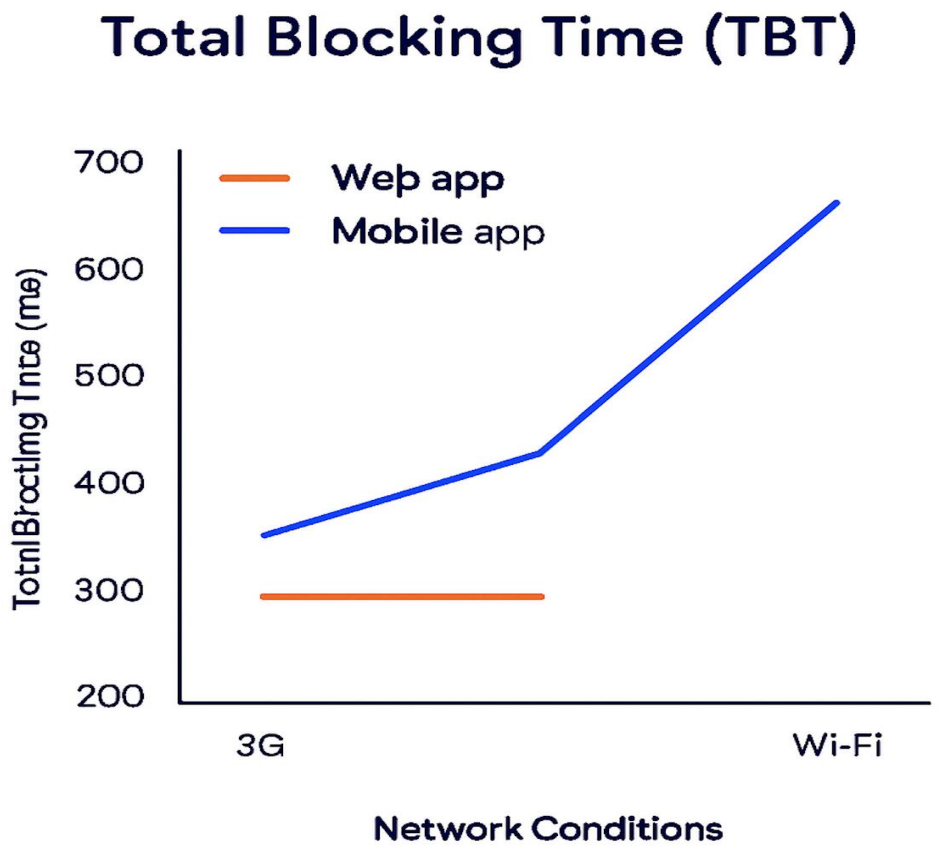
Takeaway: Web apps are resource-intensive, which can hurt performance on constrained devices.



3.4 Total Blocking Time (TBT)

- Mobile apps: Counterintuitive result — **better on 3G (281ms)** than Wi-Fi (620ms), showing **processing bottlenecks** on faster networks.
- Web apps: Lowest TBT on Wi-Fi (130ms), but still heavier overall than mobile.

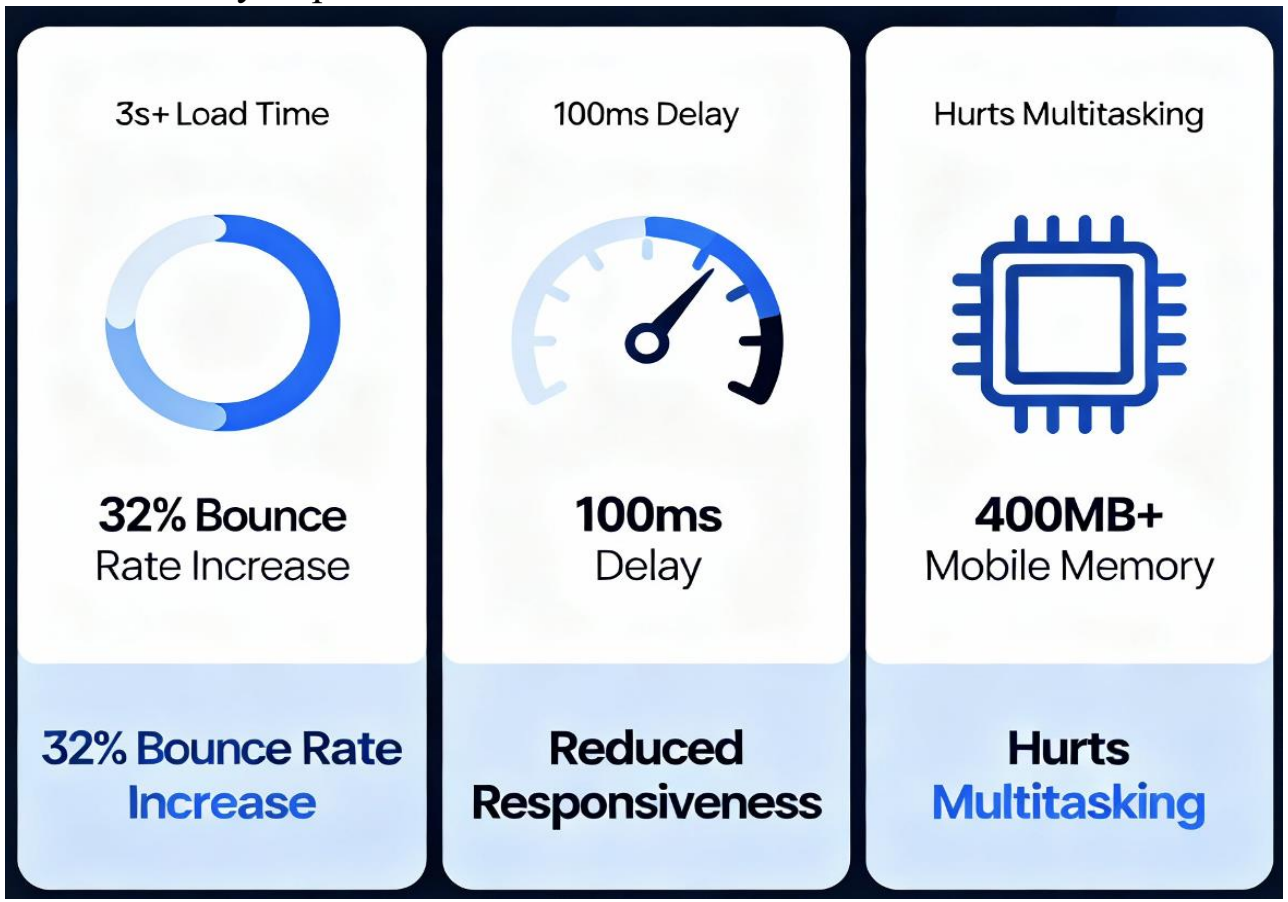
Takeaway: Faster networks can expose inefficiencies in app processing, not just improve performance.



3.5 User Experience Insights

- Bounce rates increased **32%** when load times crossed 3 seconds.
- Delays over **100ms** reduce perceived responsiveness.
- High memory usage (>400MB) reduces multitasking on mobile devices.

Takeaway: Performance directly impacts real-world user retention and satisfaction.



3.6 Strategic Insights

- Mobile-first design is essential.
- Adaptive Loading helps balance network speed with device capabilities.
- PWAs could bridge the gap by offering web apps with near-mobile performance.

4. Conclusion and Future Work

Conclusion:

- Mobile apps show superior performance across varying network speeds (74% faster on 3G).
- Web apps often experience fluctuations and increased memory usage due to browser dependencies.
- Optimization and adaptive methods are crucial for both mobile and web platforms.
- Mobile-first strategies and adaptive loading ensure better performance.
- Network-aware optimization (e.g., managing Total Blocking Time) improves user experience.
- Platform-specific resource management (lazy loading, above-the-fold content) boosts performance across environments.

Future work:

- Investigate application performance in 5G networks.
- Study how mobile device processing power influences network optimization strategies.
- Test Web Assembly in web and hybrid applications for performance gains.
- Track user actions under varying network conditions to assess real-world performance impacts.
- Explore machine learning techniques for predicting and adapting to instant network changes.
- Focus on dynamic performance optimization in real-life environments.

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