Introduction to the Mobile Web

Docs version: 2.0
Version date 7/29/2009

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The mobile web: what and why

If you're reading this, you're interested in developing a mobile website for your school – an admirable (and, as we'll see, increasingly necessary) goal. Before we go any further, let's make sure we're speaking on the same terms.

When we refer to the *mobile web* or *mobile websites*, we're talking about websites designed specifically to be usable and useful on a mobile handset, such as a mobile phone, smartphone, or handheld web device such as an iPod Touch. We're not talking about taking an existing full-featured website – designed for the large screen, keyboard and mouse, and fast connection of a desktop computer – and cramming it down to fit into a pocketable size. We're talking about designing and developing websites specifically for use on a mobile handset.

Why would we want to do this? After all, most schools already offer their students, faculty and staff rich content and functionality through full-featured desktop websites available anywhere there's a computer and an internet connection. What value does the mobile web offer a school community above and beyond what the desktop web already provides?

First, mobile is becoming an increasingly important way that people access the web. Mobile handsets outsold desktop and laptop computer worldwide in 2007, and all projections show that trend accelerating. Those mobile users aren't just talking. According to Nielsen Mobile, there were 40 million mobile web subscribers (those who pay to use the mobile web on a regular basis) in the U.S. as Q1 2008 – that's 15.6% of the U.S. mobile population. Such trends are driven not only by web-centric devices like the iPhone, but also by much less sophisticated devices like the ubiquitous Motorola RAZR.

Second, more and more content and functionality is being optimized specifically for the mobile web. Search, news, email, web banking, and other web stalwarts are all well-represented, but so are social-networking sites like Facebook, Flickr, YouTube and Twitter. Many of these are sites and services already favored by the university-age demographic.

Third, some types of content, functionality and interaction are especially useful or appropriate on-the-go. Looking up someone's contact info, searching for buildings, classes or meetings, finding things to do or places to eat, getting bus and transit routes and schedules – these activities are all even more valuable when you're walking across campus or waiting at a bus stop than when you're at your desk or in a computer lab.

The simple fact is that people – especially those represented in a typical school environment – are using the mobile web more and more, and expecting more and more from it. If your school doesn't have a plan to develop its mobile web, it should.

What's different about designing for the mobile web?

The momentum and promise of the mobile web are tempered by its constraints. Designers and developers working on mobile websites face issues and considerations different from those in the desktop world. These include:

Technical and physical constraints

- Small, dense screens: In the desktop world, 1024x768 pixels is usually considered an acceptable minimum screen size for which websites can be designed. Screens on modern mobile handsets may be as small as 128x160 pixels; the iPhone's full touchscreen is 320x480, and only a very few devices have higher resolutions. Even when mobile devices have relatively high-resolution screens, their small physical size means that the pixel density is very high – making images and text that look good on desktop screens illegibly small on the mobile screen. Mobile websites must be designed with both small screens and high pixel densities in mind.
- Limited input: Many basic mobile handsets still rely on numeric keypads for text entry. Even those with full physical or onscreen ("soft") keyboards are so much smaller than a full desktop keyboard that text-entry speeds are much lower than with desktop computers.
- Limited feedback: Unlike web browsers on desktop computers, most mobile browsers don't allow for 'hover' or 'mouseover' effects, in which a clickable link or button on the web page visibly changes to indicate that it's a clickable target. This makes it important that clickable targets in mobile websites are visually obvious without requiring a discovery process.
- Slow (and expensive) data: Even with the spread of high-speed 3G (third-generation) and nascent 4G wireless networks, mobile networks are still slower than broadband desktop connections. High-speed, unlimited-use data plans are also relatively expensive (making them less attractive to students), and their use is limited geographically. This makes it important to limit file sizes and the number of images and other downloaded items in mobile web pages – even for high-end 3G and WiFi-capable devices.
- Limited web browsers: Most mobile web browsers offer poorer support for formatting and functionality than desktop web browsers did ten years ago. They typically have few built-in fonts, very limited text formatting, and very limited and inconsistent CSS support. The situation is improving rapidly – the iPhone's web browser revolutionized the state of the art, and the response has been a rush of new, more capable mobile web browsers by software companies (Firefox Mobile, Opera Mobile and Opera Mini, Google Android, Palm Pre, and others) and device manufacturers. However, the majority of mobile devices still ship with relatively simple web browsers. This presents a twofold challenge to mobile web developers: designing mobile websites that work acceptably on low-end devices and browsers while taking advantage of what more capable platforms can support.
- Limited security: Unlike the desktop world, not all mobile web browsers support strong encryption, security certificates, and other security measures. This makes it problematic to deliver sensitive data or functionality via mobile websites.
- Limited personalization: Some mobile web browsers do not support cookies or other tokens required to support personalization – the tailoring of content, functionality and presentation for individual users.
- Very wide range of device capabilities: The sheer variety of device and platform capabilities makes it difficult to develop for, and test on, an even minimally representative set of devices for your user group. Much more than desktop web developers, mobile web developers must resign themselves to the inevitability that their sites will not display or function correctly for all users on all devices.

Attentional context

A user browsing the web on a desktop computer may be expected to be devoting focused attention to the act of web browsing. This is what interaction designers call a *sovereign* activity. By contrast, a mobile user may be walking, talking, listening, or otherwise engaged in other activities that occupy the user's primary attention; using the mobile web in such contexts will be secondary, momentary and/or interruptible – a *transient* activity. A desktop web user may be expected to spend minutes or tens of minutes on a website; a mobile web user may be expected to spend tens of *seconds* on a comparable mobile website.

General principles

The design and structure of mobile websites must reflect both the promise and constraints of being mobile. Some general principles include:

Carefully selected content and functionality

A mobile web user would be unlikely – or simply unable – to read a thousand-word article, write an essay, organize their complete photo collection, or browse the Library of Congress while on the go. Typically, a mobile website should present a subset of what a comparable desktop website would offer. Whereas desktop websites may be designed to be both wide and deep, mobile websites should typically be narrow and shallow, presenting fewer, simpler ways of accessing content and functionality carefully selected and designed for the mobile context. Comparing the desktop websites for CNN, Facebook, Amazon.com, and others can provide good illustrations of such selection and design.

Simple navigation

All mobile devices have scrolling/selection mechanisms which are slower and/or less accurate than a mouse or trackpad on a desktop or laptop computer. In addition, the smaller screen size means that fewer navigation options can appear onscreen at a time, which means that users have to scroll even to see where they might be able to go next. These factors argue for making navigation on mobile websites as simple as possible, with major navigation options located near the top of the page, streamlining navigation options per page as much as possible, and structuring mobile websites to be no more than a few levels deep.

Device segmentation and content adaptation

The balkanization of the mobile web browser market makes it impossible to design and develop mobile websites that look and work consistently across all users' devices. However, the same factors make it impossible to develop, test and support different versions of mobile websites for each and every device and browser. The solution is to group the target user group into a small number of platform categories, and develop versions of your mobile website optimized for each category.

For the initial release of the MIT Mobile Web, we settled on three categories:

1. **Feature phones:** Basic flip, slider and bar-type phones like the Motorola RAZR. These devices typically have screens with 176x220 pixel resolution (ranging from 128x160 to 240x320); numeric

keypads instead of full alphabetic keyboards; and a 4-way “D-pad” type navigation control. They also typically have limited web browsers, such as Access NetFront.

2. **Smartphones:** Windows Mobile, Blackberry, PalmOS, and similar devices. These devices typically have screens with 240x320 pixel resolution (ranging up to 320x480 and even higher). Most have physical alphabetic keyboards; those that don’t typically have onscreen software-based keyboards. They have more advanced web browsers, such as Mobile Internet Explorer, Opera Mobile, Palm Blazer, or Blackberry’s proprietary browser. These devices are also more likely to support high-speed 3G connections and/or WiFi. However, this market segment is the most diverse. Palm and Blackberry devices are very popular, but their web browsers are the least capable in this category – comparable in many ways to feature-phone browsers. Windows Mobile devices have a more capable browser, but their wide range of form factors makes it difficult to optimize consistently for all devices.
3. **iPhone and iPod Touch:** These devices merited their own category because their users are dramatically more likely to browse the web on their devices than any other mobile device – 85% compared to 59% for smartphone users and 13% of the overall mobile device market as of March 2008. The iPhone and iPod Touch also represent the fastest-growing segment of the web browsing population (not just the mobile web browsing population), and the iPhone is has the fastest-growing share of the broader smartphone market. In addition, the Safari web browser in these devices is far and away the most advanced and standards-compliant of all of the mobile web browsers. The browser engine it’s based on (Webkit) is shared by many of the next generation of advanced mobile web browsers. Finally, at the time the MIT Mobile Web was conceived and launched, the iPhone had unique buzz, not just in the mobile device market but in popular culture at large. Optimizing a version of the MIT Mobile Web for the iPhone was thus a good way to showcase the technical possibilities of the mobile web and take advantage of the popularity of this device class.

After this decision was made and the design and development of the MIT Mobile Web was well underway, it became increasingly clear that the first two categories would be defined by their respective lowest common denominators: highly popular devices like the RAZR, Palm, and Blackberry which had very limited web browsers. In fact, the design and development for these two categories largely converged, with the primary differences being related more to screen size and presumed typical network speed than browser capabilities.

Updated device segmentation and content adaptation

A year after the initial release of the MIT Mobile Web, it became clear that the original three device categories would not continue to adequately address the needs of the MIT community. The specific trends included:

- The iPhone and iPod Touch continued to dominate traffic to the site (60-70% of all mobile traffic, matching broader industry patterns).
- The first Google Android phone (the T-Mobile G1) and the Palm Pre introduced new devices with Webkit-based browsers and capacitive touchscreens very similar to the iPhone’s but lacking certain features that supported advanced functionality in the iPhone-optimized version of the site.
- A wide range of new touchscreen devices reached the market, including the BlackBerry Storm, LG Dare, Samsung Instinct, and many other similar devices. Based on the underlying OS and hardware and limited browser capabilities, these devices fit into the existing ‘feature phone’ and ‘smartphone’ categories; however, the touch-driven navigation on these devices makes linearized, text-based navigation inefficient and even physically difficult.
- It became clear that the ‘feature phone’ category represented a tiny (and shrinking) portion of traffic.

Based on these trends and patterns, the team decided to consolidate the ‘feature phone’ and ‘smartphone’ categories into a single new ‘basic’ category, introduce a new ‘touchscreen’ category, and broaden the ‘iPhone/iPod Touch’ category to address other touch-driven Webkit-based devices such as the Android phones and the Palm Pre.

The new device categories as of August 2009 are:

1. **Basic phones:** Devices with simple web browsers and d-pad (or trackball/trackpad/joystick) navigation. This is the consolidated smartphone/feature phone category, with linearized text-based navigation and minimal use of graphics. For this category, the site is now optimized for 240x320 screens; devices with smaller screens can still access the site, but some graphics may appear compressed or require scrolling to view. In addition, the site now gives this category (for browsers supporting cookies) the ability to increase or decrease the font size.
2. **Touchscreen devices:** Devices with large touchscreens but lacking Webkit-based browsers. This category includes popular devices like the BlackBerry Storm, Samsung Omnia, LG Dare, Samsung Instinct, and similar devices. For this category, the site uses a grid-based iconic homescreen similar to that of the iPhone/Webkit version, and a user experience optimized for touch-driven navigation but adapted to the lower capabilities of the browsers in this category.
3. **Webkit devices:** Touchscreen devices running advanced web browsers based on Webkit. This category includes the iPhone, iPod Touch, Android-based devices, and Palm Pre. As of 2009, all of the devices on the market and in the known industry pipeline have capacitive touchscreens running 320x480 resolution in a 3-3.5" size, and all the devices have 3G and WiFi for fast data access. A slightly generalized version of the previous iPhone/iPod Touch version of the site is served to all devices in this category, with very minor CSS adaptations for different devices and some extra features enabled for the iPhone's advanced feature set.

Platform-specific considerations and adaptations

In the MIT Mobile Web, we decided to present exactly the same content and functionality for all users, but to adapt the presentation to suit each device category. We employed many different types of specific adaptations; some of the most notable include:

Paging of content

Small screens require paging of content, especially long lists. Feature phones' smaller screens and more limited navigation controls require paging content into smaller blocks, while the iPhone's touch gestures make scrolling even long blocks of content relatively easier. As a rule of thumb, we broke long lists into 20-item pages for basic phones, and 100-item pages for touchscreen devices.

Touch-driven navigation

Touch-driven devices (in our Touchscreen and Webkit device categories) require finger-sized link targets (hyperlinks, buttons, etc.). Human-interface guidelines from Apple, Google, Motorola and others have converged around a minimal tappable target size of between 6 and 7mm square.

CSS and script support

Our original feature-phone and smartphone categories included popular devices with limited CSS and Javascript support, which limited our ability to design polished, interactive interfaces for those devices. In general, we did not rely on Javascript at all for those categories. In CSS we could not rely on any consistency in font choice, size, or styling; floats or positioning; or even consistent handling of sizes, margins, or padding. BlackBerry devices prior to BlackBerry OS 4.5 (including the popular 88xx series and original Curve 83xx), ignored all vertical margins and padding on <div> and <p> elements, forcing us to use extra tags to create vertical whitespace. Even some of the latest BlackBerry devices (including the Storm) ship with Javascript turned off by default.

Image sizes

For each category, we sized images (such as campus maps, photographs, and user-interface elements) for the smallest common screen size we expected (taking into account the screen space taken by system status-bar and web browser interface elements):

Category	Most common screen resolution	Image size limitations
Basic	240x320 or 320x240	200x160
Touchscreen	240x400 and higher	200x200
iPhone and iPod Touch	320x480	290x370

Basic-specific adaptations

To better address the needs of users of basic, text-oriented devices, we include the following refinements to the Basic version of the site:

- Consistent access-key shortcuts to the most common navigation choices on each screen. Many basic phones allow links on the page to be activated with an "accesskey" – a physical key on the device. This makes navigation much easier and faster than scrolling with a D-pad or cursor control, selecting a link, and pressing a button to activate that link. In the MIT Mobile Web, "0" (zero) is always reserved for the "MIT Mobile Web home" link, and "1" is always reserved for the home screen of the current module (except on the MIT Mobile Web homepage). Additional access-key shortcuts are available on each module's home screen.
- Font-size selection: At the bottom of every page in the Basic version of the site is a set of links allowing the user to select alternative font sizes. This feature allows users with unusually high-resolution (or low-resolution) screens, or with limited eyesight, to select a font size which makes the site more legible and usable. For most devices, this selection persists from page to page and from visit to visit through the use of client-side cookies. For the few devices that do not support cookies, this selection unfortunately needs to be made on a page-by-page basis. This feature works by setting a global CSS rule as follows:
    - "Small" size: body { font-size: 80% }
    - "Normal" size: body { font-size: 100% }
    - "Large" size: body { font-size: 120% }
    - "Extra-large" size: body { font-size: 150% }

Webkit-specific adaptations

Webkit-based browsers are clearly the most advanced in the mobile space and are, in fact, more advanced than some popular desktop web browsers. Webkit includes robust support not only for current standards in Javascript, XHTML, CSS, and session handling, but for next-generation features of CSS3, client-side data storage, and multi-touch, gesture-based user interfaces.

In the MIT Mobile Web, we took advantage of the following capabilities of Webkit browsers:

- Advanced CSS formatting, including absolute positioning, layered elements, and translucency
- Asynchronous image loading in the Campus Map module to allow browsing the map without reloading the entire page
- Automatic re-flowing of content when the device is rotated in the Campus Map and Shuttletrack modules, to show more or different information in landscape vs. portrait orientations

iPhone-specific adaptations

Above and beyond the general Webkit features, the iPhone's Safari web browser supports additional advanced features. These allowed the introduction of advanced iPhone-only features of the MIT Mobile Web, including:

- Advanced, fully interactive fullscreen mode in the Campus Map
- Support for certificate-based security and personalization, including the TechCASH (cashless payment system) module.
- Drag-and-drop reordering for customization of MIT Mobile Web homepage

In addition, the team benefitted from Apple's extensive web content guides, sample code, and Human Interface Guidelines for designing web applications for the iPhone. For the iPhone, we made the same decision many web and application designers have made: for this device, the user expectations (shaped by Apple's very specific guidance) are so strong and specific that we felt it best to design our web application to look and feel much like a native iPhone application. This also provided a solid foundation for developing the subsequent generalized Webkit and touchscreen versions of the site.

Device detection

In order to deliver optimal content for each device category, we need to be able to determine what device each user is using. For this, we used the open-source WURFL (Wireless Universal Resource File), "an XML configuration file which contains information about capabilities and features of many mobile devices" (http://wurfl.sourceforge.net).

For more information on device detection and segementation, please see the developers' documentation for the MIT Mobile Web.

Testing

Test early, test often. From early in design through development, launch and beyond, we've tested the MIT Mobile Web on as many devices as physically possible, including many devices in each of our categories. However, there's no way that we (or you) can maintain an exhaustive test suite of devices. So we turned to Device Anywhere, a paid service that "provides access to hundreds of real handsets, on live worldwide networks, remotely over the Internet - for all your dev/porting /testing needs" (http://deviceanywhere.com/). The ability to test quickly and cost-effectively on a wide range of different devices proved invaluable (if not always 100% reliable!).

However, keep in mind that the user's physical relationship with the device does make a difference. Touch-driven devices, such as the iPhone and BlackBerry Storm, are much better tested in person if at all possible. In general you should have at least a few representative examples of each device category on hand so you can remember what it's like to read, navigate and type on different kinds of devices in the real world.

During development and our beta release, we also engaged in two rounds of usability testing. The first round was conducted in a usability lab and was meant to generate quantitative usability data for specific tasks performed on devices in different categories. The second round was conducted outdoors near the student center and was meant to collect qualitative feedback on user interest, success and satisfaction. Both sets of tests provided valuable insights that helped us refine the MIT Mobile Web before its public launch.

Conclusion

Creating a mobile website is a timely and increasingly necessary part of any web strategy. However, it presents unique and constantly evolving challenges. Your mobile web can only be a success if you:

- keep in mind the mobile user in the mobile context
- select, streamline, design and develop your content and functionality appropriately
- adapt your design as appropriate for different categories of devices
- continue to test, refine and update your site as the mobile market evolves

Designing and developing the MIT Mobile Web has been a tremendously fun, educational and rewarding experience. The best part of all is that as soon as we released it, the feedback was immediate and overwhelmingly positive – this is something that's genuinely cool and useful on a daily basis for people in the MIT community. Best wishes for similar (or greater!) success as you get your own mobile web underway.

Further reading

- *Mobile Web Design* by Cameron Moll: http://mobilewebbook.com/
- dotMobi Mobile Web Developer's Guide: http://dev.mobi
- Global Authoring Practices for the Mobile Web: http://www.passani.it/gap
- WURFL: http://wurfl.sourceforge.net/
- Device Atlas: http://deviceatlas.com/
- Device Anywere: http://deviceanywhere.com/
- Apple iPhone web and application guidelines (free Apple Developer Connection account required):
  http://developer.apple.com/documentation/AppleApplications/Reference/SafariWebContent
  http://developer.apple.com/webapps