

TABLE 1

Some examples of known hand-held devices and their respective display configurations.			
Device:	pixel count	pixel density	display size (diagonal inches)
IPM Myfriend eBook	640 × 960	150 ppi	7.7"
Millitech Saturn PDA	640 × 480	200 ppi	4.0"
Pogo nVoy Communicator	320 × 240	114 ppi	3.5"
Cyberbank PC-e Phone	640 × 480	200 ppi	4.0"
Fujitsu LOOX T5/53W	1280 × 600	141 ppi	10.0"
e-Lab p40 IA Pad	1024 × 768	202 ppi	6.4"
Sony Clie PEG-NX80V	320 × 480	152 ppi	3.8"
Samsung iTodo Mega-PDA	800 × 480	187 ppi	5"
Aqcess Tablet PC	768 × 1024	123 ppi	10.4"
Casio MPC-501 Mini-Tablet	800 × 600	149 ppi	6.7"
Palm Tungsten C	320 × 320	150 ppi	3"
HP iPaq H5550	240 × 320	105 ppi	3.8"
Nokia 7650 data-enabled phone	176 × 208	128 ppi	2.1"
T-Mobile Sidekick(by Danger Inc.)	240 × 160	115 ppi	2.5"
Nokia Communicator 9110	640 × 200	150 ppi	4.4"
DataWind Web access device	640 × 240	128 ppi	5.34"

**[0011]** Each of the mobile devices above and all known conventional hand-held mobile devices today have some attribute that makes Web access on that device uncomfortable for most people or that makes the device too big to fit comfortably in most people's pockets. For example, the devices with displays whose pixel counts are 320×480 pixel or smaller simply cannot display enough of a Web page: User's have to scroll too much, and they suffer from the disorienting "looking through a straw" phenomenon. On the devices with pixel densities over 175 pixels-per-inch (175 ppi), Web pages are rendered to small for most people to comfortably read smaller text on most pages (if they can read the text at all). The devices that are over 6 inches (in width or height) are too big to fit comfortably in most people's pockets. Known devices using conventional displays are often larger in width or height than the diagonal length of the displays, since the frames around the devices often are made large enough to hold buttons and controls. The "Pogo" device's frame does not include buttons or controls, but the Pogo device's display is only 320×240 pixel.)

**[0012]** Most of today's mobile devices also have displays that are taller than they are wide (sometimes referred to as "portrait" orientation rather than "landscape" orientation). So, for example, the Sony CLIE device mentioned above is only 320 pixels wide, which means less than 40% of a typical Web page's width is visible at any give time. As noted above, the resulting experience with these devices is that the user feels like they are looking at Web pages "through a straw", seeing just a small portion at a time, with extensive scrolling required to browse the full page. This effect may be simulated by opening a Web page on a desktop computer monitor and shrinking the Web browser window so that only a small portion is visible.

**[0013]** Even if the Sony CLIE with its 320×480 pixel display were changed to display Web pages in landscape orientation—480 pixels wide by 320 pixels tall—the portion of a Web page visible at any given time is still too small to result in satisfying general purpose Web browsing, in our experience. Such a device could only display 1/3 the number

of pixels that a user typically views on a desktop computer (e.g. 1/3 of 800×600 pixel). More importantly, such a device is only 60% the width of a typical 800 pixel wide Web page. That would certainly be better than trying to browse a Web page on a device with a 160×160 pixel or 240×320 pixel display, but our experiments (using Web browser windows shrunk to various pixel dimensions) indicate that browsing with a 480×320 pixel wide display (let alone all the current devices that have even smaller pixel counts) is too limiting to allow for satisfying general Web access over extended periods of use. It still requires too much scrolling and it still feels like "looking through a straw" at the Web pages.

**[0014]** There exist unresolved needs of many companies in the wireless service and mobile device industries. Among these needs is the need to significantly improve the mobile Web user experience on pocketsize devices, in order to attract more subscribers to emerging mobile Web services. Several early mobile Web services failed in large part because potential subscribers did not find the service compelling enough given the limitation of conventional pocketsize devices, and they did not want to carry around non-pocketsize devices. (Examples of these unsuccessful early mobile Web services include Monet Mobile, Omnisky, GoAmerica, and Metricom's Ricochet service.)

**[0015]** Some companies (such as Danger Inc.) offer services that attempt to shrink Web content into a format more suitable for low-resolution displays (such as the 240×160 pixel displays in devices designed by Danger Inc. for T-Mobile and other wireless operators). However, most Web content is designed for much larger displays, and accessing shrunk or transformed versions of most pages leads to display or interaction problems (ranging from ugly formatting to broken interaction features) and results in a Web access experience that most people find far less satisfying than accessing the Web on a desktop or notebook computer. This, along with the "looking through a straw" phenomenon discussed above, are among the reasons that very few people use today's hand-held devices to access the Web, even though wireless Internet networks are now widely available (for example, from service providers such as Sprint PCS, Verizon, T-Mobile, and AT&T Wireless in the U.S., as well as most wireless operators in Europe and Asia). Today's "wireless Web", accessed through today's hand-held devices, is simply nothing like the real Web that hundreds of millions of people enjoy accessing on their desktop and notebook computers.

**[0016]** One device that takes a different approach than most others is the PC-EPhone by a company named Cyberbank. The PC-Ephone uses a 4" diagonal display that is 640×480 pixels. That is enough pixels to display most of the width of a typical Web page, which is a step in the right direction. However, to keep the device small, Cyberbank's device squeezes all of those pixels onto a display that is only about 4" diagonal, making the display's pixel density about 200 dots per inch (ppi). That means that about 80% of a typical web page's width (i.e. 640 pixels of a typical Web page's 800 pixel width) is displayed on a display that is less than 3.5 inches across. That makes the Web pages uncomfortably small for most people, particularly when trying to read the text on most Web pages: Print on typical web pages appears exceedingly tiny on the PC-EPhone device. Furthermore, even though Cyberbank used a display with very high pixel density (i.e. very small pixels), their device is