A technical review of mobile computational devices

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Mobile technology is changing so fast, with new products being introduced daily, that any review of specific devices will rapidly be so out of date as to be unhelpful. Thus, this review focuses on general classes of device, with examples of manufacturers and machines for illustration only.

There is a major convergence of technology in progress, which some view as leading towards single devices with multiple functions such as mobile phone, multimedia computer and digital camera. Others predict a host of mobile activities (e.g. digital imaging, video, location sensing) and many different devices offering subsets of these. Whatever the outcome, the trend is towards a greater variety of technologies. New mobile phones are capable of video calls, multimedia and video messaging, and loading and running programs such as interactive games or teaching packages. Some handheld computers have built-in high speed wireless connection to the Internet either through Wireless LAN or GPRS phone link, or both. New pen tablet computers come with full Windows operating systems and wireless LAN connection and so can function like laptop computers as well as notetaking devices. Over the coming decade the convergence will continue, to embrace mobile Internet gaming, remote monitoring (e.g. of household appliances or laboratory experiments), and mobile interactive television.

Currently, mobile computational devices can be divided into six general categories, in rough order of computational power: wrist-worn devices, mobile phones, handheld computers and PDAs, web pads, pen tablet computers and laptops.

Wrist-worn devices
As well as telling time and date, some wristwatches can now measure temperature and barometric pressure, altitude, and heartrate, or act as GPS location devices or MP3 music players. Intended for specific interests or activities, they are not designed as cut-down computers and generally have no or limited connectivity with other mobile devices.

Mobile phones*
Most mobile phones now use digital telephony and are capable of sending and receiving data, though at slow speeds (9.6 kilobits/sec). Some older multimedia phones such as the Nokia 9210 use standard GSM connection, which means that while reading email can be acceptable, browsing the web is painfully slow. The newer GPRS system offers higher data rates and ‘always on’ connection, making it possible to browse the Internet, send multimedia messages and receive and send

* Sources: manufacturers’ specifications
email. An example of a GPRS multimedia phone is the Sony Ericsson P800. It has a large 208 × 320 touch sensitive screen like a handheld computer, with a number-pad that folds over part of the screen so it can be operated like a normal mobile phone. It offers personal organiser functions, plus a camera, audio and video player. Its Symbian operating system, however, is different to that found on handhelds so that it cannot run standard Pocket PC or Palm programs. The ‘third generation’ or 3G phones, such as the Siemens U10, allow even faster speeds of connection, for receiving video or making videophone calls.

Handheld computers∗

Until recently handheld computers (also known as palmtop computers) offered a limited range of tools and were designed either as personal organisers (such as the Palm) or note takers (such as the Psion). New handhelds offer almost as wide a range of applications as a desktop PC, including MP3 music players, web browsers, and paint packages. Almost all use a stylus to input data, although both older machines such as the Psion and newer ones such as the Tungsten W have built-in keyboards. The handhelds can be classed according to their operating systems: PalmOS, PocketPC, EPOC and Linux.

A typical low end PalmOS machine is the Palm Zire. This has a relatively old Motorola Dragonball EZ 16 Mhz processor and only 2Mb of built-in memory. It is light (109 g) and small (112 mm × 74 mm × 16 mm), but has a 320 × 320 monochrome display, no expansion slot to add extra memory or accessories, and no audio capabilities. All PalmOS devices can connect to a desktop computer and synchronise data with calendar and address book programs. The Palm range was designed from the outset to be thin enough to put in a pocket and easy to operate for basic personal organiser tools. Note taking is done using the stylus on a part of the screen that recognises stylised ‘graffiti’ characters. About 30 min of training is needed to learn how to input text and from then on the recognition is reasonably fast and accurate.

The higher-end palm OS machines such as the Sony Clie PEG NX70V have a keyboard, a colour 320 × 480 pixel screen, a digital still and integral movie camera, with a slot to add Sony’s own 802.11b wireless LAN and also a memory stick with up to 128Mb memory. The NX70V has a 200-MHz Intel processor, 65,536 colour TFT screen and 16Mb of built-in memory.

PocketPC handheld computers, such as the HP iPAQ are designed as Windows computers in the hand. The interface is similar to Windows, with a Start button for accessing software applications and screens and a file browser like that on a Windows desktop PC. The front ‘Today’ screen gives an overview of activities such as appointments, unread emails, and pending ‘to do’ items. Synchronising files and Outlook tools with desktop computers is easy using the built-in ActiveSync software. One key difference from PalmOS computers is that more than one application can be running at once. It is easy to click between applications, but having too many open causes the system to run very slowly as it tries to manage its limited memory.

A typical basic machine is the HP iPAQ 1910, with an Intel 200 MHz chip and 64Mb of built in memory (46 Mb accessible to the user), plus an SD slot to add

∗ Sources: *PDA Essentials, Issue 13, 2003* and online manufacturers’ specifications
further memory. It is relatively small (1220 mm × 78 mm × 13 mm) and light (120 gm) with most of the area taken up with a bright colour 240 × 320 pixel screen. Unlike low-end Palm machines it has a microphone, speaker, and an earpiece jack. The battery life is somewhat low (HP claims four hours) but with the option of swapping batteries. At the other extreme, the H5450 comes with Bluetooth to communicate with other devices such as mobile phones, 802.11b to connect to a wireless LAN, and built-in fingerprint recognition to stop unauthorised access. It has 64Mb of memory and a 240 × 320 screen, as well as a fast 400 MHz processor. Others making PocketPC computers include Toshiba, Acer, NEC, and Mitac. Siemens and xda manufacture PocketPC computers with a built-in GSM phone.

Only a few companies, including Sharp and Yopy, offer Linux handheld computers. The Yopy YP3500 is almost a miniature laptop computer, with a ‘clamshell design’, keyboard and the Linux operating system. The Epoc operating system is now only found on the discontinued Psion computers.

Web pads

The term ‘web pad’ was coined by National Semiconductor in 1998 to describe a wireless tablet computer that is specifically designed to access the Internet. The idea was that home or school users would not want a fully specified laptop or tablet computer, but rather a machine that provided the two basic functions of web browsing and reading email. A small number of companies such as Amstrad, Fujitsu and Hitachi manufactured webpads, but high level of interest during 2000–2001 evaporated with the arrival of more fully specified pen tablet computers.

Pen tablet computers

The pen tablet computer has a long and honourable history, dating back to the far-sighted Xerox Dynabook project of the early 1970s. Kay and Goldberg wrote:

> Imagine having your own self contained knowledge manipulator in a portable package the size and the shape of an ordinary notebook. Suppose it had enough power to out race your senses of sight and hearing, enough capacity to store for later retrieval thousands of page equivalents of reference materials, poems, letter, recipes, records, drawings, animations, musical scores, waveforms, dynamic simulations and anything else you would like to remember and change (Kay & Goldberg, 1977).

That dream has now been realised. In the late 1990s companies including Fujitsu began to produce machines with the functionality of a laptop computer, including the full Windows operating system, but in a package the size and shape of a thick A5 or A4 notepad. They had touch sensitive colour screens operated by a stylus and some provided docking stations and infrared keyboards so that they could also be used as desktop replacement computers. Tablets found a niche in markets such as medical record keeping and technical fault-finding, as well as in education as an ‘electronic schoolbook’ and Microsoft produced the Windows CE operating system as a cut-down version of Windows for tablets and other portable machines.

In 2002 Microsoft produced a new operating system for Tablet PCs, the Windows XP Tablet PC Edition, along with a set of hardware specifications for manufacturers designing hardware for that system. The requirements include (in simplified form) that the tablet must:

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\* Sources: www.pencomputing.com/frames/textblock_webpads.html and manufacturers’ specifications
• use an active digitizer rather than a resistive (touch) digitizer;
• be legacy-free (no serial, parallel or PS/2 ports);
• be able to rotate the display between landscape and portrait without rebooting;
• resume from suspend in less than 2 seconds;
• last in suspend mode for more than 72 hours, starting with a full battery
• automatically hibernate (save to disk) upon battery exhaustion in suspend mode;
• allow surprise removal from a dock; upon reinsertion, everything must work.

The operating system offers a number of features specifically for tablet computers such as handwriting recognition (with accuracy varying from very good to barely acceptable dependent on your style of handwriting), note taking facilities, text searching of handwritten notes, document annotation, and speech recognition.

A number of manufacturers produce tablet computers that conform to this specification including Compaq, Toshiba, Fujitsu, Acer and Research Machines. Although they all have the same operating system and thus can run the same software applications, the specification and appearance of the different manufacturers’ machines differs widely. Two contrasting examples are the Toshiba Portégé 3500 and the Compaq TC1000.

The Toshiba machine looks like a conventional ‘clamshell’ laptop computer, but the screen can rotate and fold back flat on the keyboard to make a (somewhat bulky) tablet computer. It has a fast 1.33 GHz Intel PIII mobile processor, a standard 256 Mb memory and a 20Gb hard drive. The 12.1 inch screen has a 1024 × 768 resolution high colour display. The active pen has a ‘hovering’ capability, so that the cursor follows the pen even when it is not touching the pad. The machine has most of the connectivity of a standard laptop including 802.11b wireless connection. The manufacturer’s claimed battery life is 3.5 hours although a typical duration would be 2.5–3 hours.

The Compaq computer is a tablet device that can be slotted into a keyboard, giving it the ability to change from a tablet to notebook PC. It uses the FinePoint Digitizer stylus, which does not have pressure sensitivity and needs an AAAA battery, but performs well near the screen edges. The Compaq machine has a 1GHz Transmeta TM5800 Crusoe chip, which is slower than the Toshiba’s, particularly when the unit is first turned on or an application is being launched for the first time. The advantage is a longer battery life, which is 3.5–4 hours when power management is set to automatic, but around 5 hours if power management is set to Maximum Battery. It has a smaller 10.4 inch screen with 1024 × 768 resolution and comes with built-in wireless LAN, a 30Gb hard drive and standard PC-type connections.

Research Machines manufactures a tablet aimed at the education market. It is light (1.4 Kg) and relatively inexpensive, but with no keyboard. It comes in a student edition and a teacher edition (with a faster processor and additional connectivity). Both versions have integrated 802.11b wireless LAN.

Laptop computers
Laptop computers are now so ubiquitous as to need no detailed survey. They range from small light machines (though these are being overtaken by pen tablet computers) to desktop replacements with 17 inch screens.

Reference