The Future of Computers

L D Howe
Serco Assurance*, Culham Science Centre, Abingdon
Oxon, OX14 3ED, UK

November 2001

Executive Summary

Computers are becoming very small. Twenty years ago computers were, to most people, expensive scientific toys. Today's pocket computer has many times more memory capacity than the old mainframe computers, is much faster and costs a fraction of the price. Using a modified definition, the first computers would have been cave walls and stone tablets. Ordering and manipulating information became much easier with the invention of sheet paper. A modern computer still has considerable disadvantages over sheets of paper. This discourse envisages a computer the size of an A4 sheet of paper, which can be folded or rolled to take up less space. School children and students will have what is effectively a single sheet of paper (the Sheet) to record all their work and contain all the texts they need. At work, the Sheet will greatly reduce the requirement for space and improve the environment in which we all work. In the home and on journeys the Sheet will transform our way of doing things. Telecommunications will be revolutionised. We will be able to carry information about with us and process it anywhere. Almost everything we do will be connected with the Sheet in some way. Current technology already encompasses most of the Sheet's functionality. It is simply a matter of refining the technology, of integration, miniaturisation and packaging.

Contents

1   Introduction

Computers are becoming very small. A little over twenty years ago, I built my first desktop computer. Today's pocket computer has a thousand times more memory capacity, is fifty times as fast and costs about the same at today's prices, which in real terms is about one tenth of the cost. Twenty years ago computers were, to most people, expensive scientific toys. Of course, there was extensive use of computers in the worlds of science and commerce, but the smallest of these machines were the size of a large broom cupboard. In order to use such a machine, specialists were needed to encode the data and the output was in the form of large volumes of continuous stationery in a tabulated format. Where will it all end? To understand what the future might hold, it is useful to consider the history and development of the computer.

2   A Brief History of Computing

Today we think of computers as high speed electronic calculating machines, capable of processing millions of data every second. However, it was not always like that. The first fully automatic calculating machine, demonstrated by Charles Babbage in 1822, was a purely mechanical device. Many mechanical devices were invented and used over a period of about three hundred years. The first purely electronic computer, ENIAC, did not appear until about 1947. To understand what we mean by the term computer, I propose the following modified definition:

> *A computer is a device that captures and stores information in such a way that the information can be manipulated, ordered and made available for use external to the device itself.*

Using this definition it is clear that the first computers would have been cave walls and stone tablets. Admittedly, manipulation and ordering of information on a cave wall would have required pre-planning and lots of space. It is interesting to note that computers, using this definition, would have been used first for graphics, then words and finally numbers, whereas the order was reversed in the development of the modern electronic computer. Crude and cumbersome as stone was as a computing device, it must have represented an enormous leap forward for a society previously restricted to a very limited vocabulary and gestures.

By Egyptian times, stone had been replaced by sticks, papyrus and parchment. Ordering and manipulating information became much easier because the information could be stored in a more easily managed form. However, the real breakthrough came with the invention of sheet paper. If information is stored on relatively small sheets, the sheets can be sorted, amended and replaced almost at will. The main problem associated with sheet paper is that it requires careful writing if it is to be legible and it is a laborious business to make copies. However, if the information is compiled into books which can be stored in a library, the effect is that it becomes much more accessible. Students of a any subject can visit a library, extract the information they require and convert it into a new set of "processed" information by writing papers or another book. Researchers today often use the same methodology.

The process of mass reproduction was not solved until the invention of the printing press. However, the printing press spawned its own, new problems. To prepare a book or other form of paper-based information, specialist craftsmen were required to make and set the type. This in itself was a long and laborious operation. However, compared with copying out the work it did not represent an enormous increase in time and, once done, many copies could be produced with little extra effort. One of the chief advantages of the printing process was that typeface became standardised and, therefore, writing more legible. The invention of the mechanical typewriter allowed relatively unskilled workers to produce output of the same legibility, but had the disadvantage of making only one or two copies (using carbon paper).

During this period, numerical computation had progressed through tables, logarithms, mechanical and electromechanical devices to the first electronic computers. Effectively there had been a divergence, with different techniques being used for text-based, graphical and numerical computing (using our modified definition). The way back to the original definition, with a unified computing capability, really began with the advent of the word processor. The word processor combined the ease of composition of the typewriter with the capability of mass reproduction of the printing press. Beginning as a stand-alone item, the word processor soon became incorporated into the new desktop computers. However, a computer still has considerable disadvantages over sheets of paper. Sheets of paper are small, convenient, can be written or read almost anywhere and do not require any skill other than the almost universal ones of reading and writing.

The laptop computer has addressed the portability problem to a certain extent and the pocket computer has gone even further. The disadvantages of laptop computers are that they are still relatively heavy and bulky, need recharging regularly and require typing skills. The pocket computer can accept input in written form, but usually confined to a small area. Pocket computers, by definition, are rather small, which means that the amount of information that can be viewed at any one time is somewhat limited. But these two devices do present us with a glimpse of what may become the computer of the future.

3   A Vision of the Future

Imagine a computer that is the size of an A4 sheet of paper and can be folded or rolled to take up less space. Imagine that you can write or draw on it anywhere, just like a piece of paper and it converts your writing to formatted text or neat graphics. Further imagine that it has the capacity to contain thousands of pages of information, all of which can be called up at will, sorted, analysed, processed, amended and restored. Also, our imaginary computer can transmit or receive information at the touch of a virtual button. All of this is almost within the reach of current technology. Just think what we will have at our disposal.

School children and students will have what is effectively a single sheet of paper (the Sheet) to record all their work and contain all the texts they need. They can download work for marking and make regular backups in case of loss. Exams can be taken using a special Sheet that is downloaded at the end of the exam and reloaded with the questions for the next exam session. Any allowed references and calculator functions can be loaded at the same time. Thus, using only a few of these special exam Sheets, every candidate can be examined under identical conditions and the virtual scripts transmitted instantaneously to the markers.

The office will similarly be transformed. Workers will need only a Sheet with access to any corporate information that they need via the instant receive function. With modern encryption methods, corporate secrets and sensitivities will be at least as secure as at present. Workers will be able to work almost anywhere, within the constraints of the need for face-to-face communication. Even face-to-face communication can be simulated in many cases. Present technology is still rather crude, but the Sheet will make remote meetings a reality. In recent years, desks have expanded to "workstations" to accommodate the desktop computer and all the other "gismos" of a modern office. Office workers often have filing trays and box files stacked on heating and ventilation outlets. The Sheet will greatly reduce the need for such space and improve the environment in which we all work.

In the home, we will write our shopping list on the Sheet and the goods will be delivered to our door or, if we really feel we need to make a trip, be ready for collection. We will be able to order taxis, watch television, or do any of our recreational activities, either on the Sheet or by using the Sheet to order or direct the activities. In the car, the Sheet will store our route, together with any alternatives, so that we arrive at our destination safely and in good time. On the train or bus, the Sheet will contain our favourite news media so that we can keep up to date, without litter or inconvenience to others. When we are on holiday, or even just out for a walk, the Sheet will be our map or guidebook.

Telecommunications will be revolutionised. The so-called third generation (3G) phones will go some way towards this revolution. But the Sheet will integrate almost everything we do. We will be able to control our finances, book holidays, look up information and talk to friends (or strangers, if you like chat rooms). In fact, anything we can do on the Internet at present will be possible. We will even be able to produce our own web sites on the Sheet for others to access via their own Sheets.

4   Conclusions

The advent of the Sheet is a vision of the computer of the future. With it, we will have almost gone full circle from the stone tablet or cave wall. The difference is that we will be able to share or restrict information almost at will. We will be able to carry information about with us and process it anywhere. Almost everything we do will be connected with the Sheet in some way. If this all sounds rather far fetched, remember, current technology already encompasses most of these functions. It is simply a matter of refining the technology, of integration, miniaturisation and packaging. Could the Sheet be a reality within ten years? I would like to think so.