

IN BRIEF

- The aim of the series is to show how the Internet is becoming an important tool in dentistry.
- The Internet is the vast infrastructure of networked computers that have the ability to share data around the world.
- The most popular Internet applications are email and the all-encompassing World Wide Web.
- The Internet has a short history and is continuing to evolve.

An introduction to the Internet

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The aim of this multipart series is to show members of the dental team why the Internet is becoming an essential tool and to encourage colleagues to 'get online'. The various ways of connecting to the Internet are discussed, comparing the advantages and disadvantages of each. How to use email and browse the World Wide Web is covered in some detail. There are plenty of practical tips on how to use the Internet safely and efficiently. The amount of information available on the Internet is vast and the series gives practical illustrations on how to be successful in searching for relevant information. There is an introduction on how to create a practice website and the final part looks at how to put all these skills together to make the most use of the Internet in the practice of dentistry.

THE INTERNET GUIDE FOR DENTISTRY

1. An introduction to the Internet
2. Connecting to the Internet
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5. Introduction to the World Wide Web
6. Creating a practice website
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WHY DO I NEED TO KNOW ABOUT THE INTERNET?

In a 2003 survey of dental practices in the Thames Valley Strategic Health Authority region,¹ 77% of the practices were using computerised systems (or were planning to do so soon), while only 45% were found to have access to the Internet and email. Assuming dentists have followed the general UK business trend in increased use of the Internet, one can assume that these figures are now much higher. For example, the Department of Trade and Industry-sponsored *Security Breaches Survey* in 2006,² showed that 97% of UK businesses surveyed had an Internet connection and 88% of these were broadband. Roughly 80% of companies had a website.

Some dentists are keen to have their dental practice computer network system linked to the Internet, while others choose to have a stand-alone Internet connection at work. Many more will have an Internet connection at home (often networked wirelessly around the house), or even a mobile connection via a laptop or smart mobile phone. Having a connection to the Internet is one thing, but knowing how to use it practically, efficiently and safely is another. In order to reap the benefits of this communication revolution it is

important to know a little bit about how the Internet works, what different Internet applications are available, their strengths and weaknesses and how to use them.

In February 2004, British Telecom (BT) won the contract to provide and maintain the new upgraded NHS computer network, called NHSnet/N3.³ This promises to link hospitals and GP surgeries across the country with fast broadband connections that will have the capacity to allow the exchange of visual data, such as video and X-rays. This broadband upgrade supports the NHS National Programme for IT in the NHS⁴ and it underpins three major projects outlined in the plan:

- Electronic booking systems – allowing GPs to book consultant appointments for patients online, while they wait
- Integrated care records – ensuring patients' details and treatment are available immediately, at any time of day or night, to all healthcare staff who are providing care to that patient
- Electronic transfer of prescriptions – providing an integrated system that will allow the transfer of patient medication records between GPs, nurses, hospitals, pharmacists, dentists and the patient.

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Fig. 1 The Internet is a vast network of interconnected computer networks



By ensuring that the right information about a patient is in the right place at the right time it is hoped that the NHS will be able to provide more efficient and effective patient care. With the transition of NHS dentistry to local commissioning, there are plans to integrate NHS dentistry within this move and a National Dental IT Project Team has been set up. The first priority will be to gradually link NHS dental practices to the new NHSnet/N3.

For any dentist, NHS or private, group practice or single-handed, there are many good reasons to be Internet-literate. Being able to send out email reminders to patients, transmitting digital images to dental technicians, carrying out CPD online and developing a practice website to inform existing patients and attract new ones are just some of the benefits that will be discussed in this series.

WHAT IS THE INTERNET AND HOW DOES IT WORK?

If your dental practice is computerised, the chances are that the computers are linked or networked together so that they can share information such as the appointment book(s) and patients' details. Think of the Internet as an enormous network of networks, linking computers to other computers all over the globe (Fig. 1). It is an affiliation of hundreds of thousands of private, commercial, academic and government-supported computer networks from every country in the world.

The computers are all able to communicate with one another because they all share the same protocol, called TCP/IP (transmission control protocol/Internet protocol). Each computer runs software programs to provide or 'serve' information (eg web or email server) and/or to access and view information (your work/home computer). Most dental practice networks already use exactly the same TCP/IP protocol to share data within their practice.

The Internet itself does not contain information; it is the means by which information is moved and shared. When someone says that they 'found something on the Internet', what they really mean is that it was found on one of the computers linked to the Internet infrastructure.

How does information travel on the Internet?

The computers which make up the Internet

are connected to one another in various ways; by radio waves, by satellite links, by optical fibres, by the integrated services digital network (ISDN) and by the humble telephone line, with its twisted pieces of copper wire.

IP breaks the data into small packets of information that can travel independently of each other through the networks of the Internet. The packets of data are effectively placed inside a secure 'envelope' and labelled, in much the same way as you label a parcel. The label carries an identifier, the address of the sender and the address of the recipient (Fig. 2). TCP enables two computers to establish a connection and exchange the data; it handles the delivery and arranges the order in which packets are sent and received.

The networks that comprise the Internet are connected by computers known as 'routers' and 'switches', which decide how to transmit the data most efficiently across different parts of the network. If there is a 'bottle-neck' then the router will send the next packets of data a completely different route. Because of the speed that the packets are travelling, it really does not matter too much if the physical distance travelled by the packets is greatly increased. Because they travel through different pathways, the packets frequently arrive out of sequence. The labels include information that helps reconstruct the complete message or file. If a packet of data is lost *en route*, the receiving computer requests another copy of the packet until it arrives intact. Whether you are sending an email, downloading a file or simply reading the latest news on the BBC website, you are relying on TCP/IP to handle the transfer of data between the various computers involved.

How do computers on the Internet find one another?

A host is any computer that is connected to a TCP/IP network (be it the Internet or your practice/home network). Each host has a unique IP address that identifies the computer (or device) on the network and allows messages to be routed based on the IP address of the destination. The format of an IP address is four numbers separated by dots, with each number being between 0 and 255. For example, 212.227.93.161 is the IP address for the host computer serving the GDC website. (Within an isolated network, such as a dental practice, IP addresses can be assigned at random as long as each one is unique on that network).

Computers are most efficient when they work with numbers, hence the numerical format for an IP address. Humans, however, prefer working with easy to remember words and so a system of domain names has been created such as microsoft.com or nationwide.co.uk. The DNS (Domain Name Service) is a network of computers spread throughout the Internet that translate human-friendly domain names into computer-friendly IP addresses, facilitating the traffic of data to the right place (Fig. 3).

How big is the Internet?

The ARPANET project (Advanced Research Projects Agency Network; the precursor of the Internet) started in 1969 with just four supercomputers. In January 1996 there were 100,000 web servers (computers that deliver or 'serve up' web pages). Four years later there were 9.9 million web servers and after another five years (November 2005) this number had grown to 74 million.

INTERNET APPLICATIONS

The Internet is the vast infrastructure of networked computers that have the ability to share data around the world. It is the software programs that run the various Internet applications that make the Internet so useful. The most popular applications are:

- **Email:** used in sending and receiving electronic letters. Files can also be attached to emails (eg an image, spreadsheet or Word document)
- **The World Wide Web (WWW or web):** used for browsing and interacting with the billions of pages of information held on the millions of web servers on the Internet. This information can be text, images, music and videos
- **Instant messaging:** used to send notes back and forth with friends who are online at the same time
- **News groups:** used to participate in public discussions about a particular topic
- **File transfer protocol (FTP):** used to rapidly retrieve files from a remote computer (download) or send files from your computer to another (upload).

Future parts of the series will look at these applications in more detail.

HOW HAS THE INTERNET DEVELOPED?

The Internet has a very short history but its development has been meteoric and continues at a substantial rate. It has been said that it took 38 years before 50 million Americans were listening to radio. Television got to that many in only 14 years. The Internet had 50 million users in only four years. Since reaching its critical mass, the Internet has crossed the line from being an expensive computer fad for nerds to becoming an ordinary household necessity. Today, people who have a broadband connection at home would feel absolutely lost without it.

It is true to say that the Internet evolved rather than it being invented, and it all started in 1969 with the setting up of ARPANET. This was a US government-funded project that experimented with linking computers (networking) across different parts of the country. The aim was to provide researchers and scientists with access to all of the machines, programs and data on the network.

In 1973 Vint Cerf and Bob Khan⁶ defined the 'Internet protocol' (IP) by which data is

HOW MANY PEOPLE USE THE INTERNET?

Getting figures on exactly how many people use the Internet is difficult, partly because of how you define 'use the Internet'. (Active users has been defined as someone who uses the Internet at least once per month).

According to the Internet World Stats⁵ website, by January 2007 there were estimated to be over one billion people using the Internet. The most requested languages on the World Wide Web were English (30%), Chinese (14%), Japanese (8%), Spanish (8%), German (5%) and French (5%).

World Internet usage, broken down by geographical area, was as follows: Asia (35.6%), Europe (28.6%), North America (21.2%), Latin America/Caribbean (8.1%), Africa (3%), Middle East (1.8%) and Oceania/Australia (1.7%). The greatest Internet usage as a percentage of the population is in North America (69.4%), followed by Europe at 38.6%. The biggest change in the next few years will be the explosion in the numbers of users from China. At the moment 132 million people have access to the Internet in China (compared to 210 million in the USA), yet for China this only accounts for a mere 10% of its population. It is thought that India and China combined have over half a billion people who can speak English.

broken down into small, manageable sized 'packets' before being sent from one computer to another. In 1977 the first three-network interconnection was demonstrated between California and London. The computers had the ability to re-route packets of data in the event of the message not being able to be transmitted by its chosen route, for example if the connection was busy or broken. Selected educational and research institutions were invited to join the network and share information and ideas.

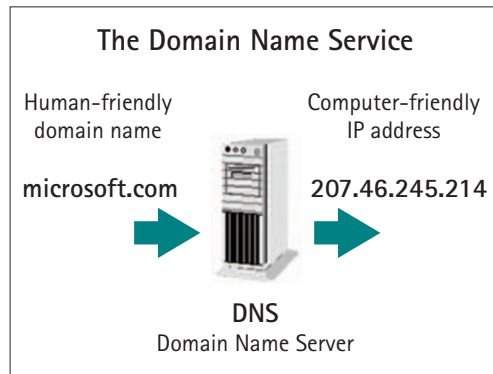
In 1980 Tim Berners-Lee,⁷ an Oxford-trained computer consultant, created a system to give every 'page' on a computer a standard address (now called a URL, or universal resource locator), accessible via hypertext transfer protocol (HTTP). Pages of text were formatted with the hypertext markup language (HTML), and visible with the first browser. This was the creation of the web.

The explosion in popularity of the Internet is a more recent phenomenon and is due to the graphical nature of the web.



Fig. 2 The IP (Internet protocol) breaks data down into small packets which are labelled before sending off into the Internet. The TCP (transmission control protocol) then deals with the delivery of the packets to the correct destination

Fig. 3 The Domain Name Service manages an ever-changing database that translates human-friendly domain names into computer-friendly IP addresses



In December 1993, a piece of Internet software called Mosaic was developed; the software was free and within six months, over two million people had downloaded it onto their computers to use. The reason for its success was that it allowed you to browse the information on the Internet with your mouse and point-and-click at links that would take you to various sites half way around the world. Websites were soon able to display not just text, but also graphics and photographs. Later it was possible to play animation, videos and sound. This made the web the most visual part of the Internet and it really caught the attention and imagination of the media and public alike.

In 1994, Bill Gates, chief executive officer of Microsoft, decided to channel a considerable part of the company's money, skills and resources into the development of the Internet. Microsoft has had a significant influence on the way in which Internet software and standards have developed. Packaging their ever-popular Internet Explorer browser software and Windows Media Player in with the Windows operating system has led to many court cases and fines in both America and Europe because of uncompetitive business practices.

Corporate businesses became more involved in the Internet as they could see the potential for improving their own communications. People soon came to realise that the real power of the Internet was not that the computers were able to talk to one another, but that people could talk to one another.

The Dot.com era started in the late 1990s when thousands of start-up companies began selling products or services using or somehow related to the Internet. There was a specula-

tive frenzy of investment in Internet-related stocks and enterprises. The phrase 'get large or get lost' was the wisdom of the day as entrepreneurs and investors became dot.com millionaires almost overnight. The dot.com bubble burst, numerically, on March 10th 2000, when the Nasdaq stock market index peaked at 5,048.62, more than double its value just a year before. Despite the crash, some dot.coms have survived, and in fact, are even thriving. Amazon, the online bookstore which now sells just about everything, finally tipped into the black in 2003 with net sales of \$5.264 billion, compared with \$3.933 billion in the previous year.

It took until 2001/2002 before broadband entered into mainstream usage. At last Internet users had a really fast connection, but it took a while before companies started putting 'broadband content' onto their websites. It also started becoming harder to distinguish when you were actually on the Internet, blurring the lines between what was sitting on your desktop and what was coming in from the web. Popular programs that did not use the normal web browser included instant messaging clients, file-sharing programs, automatic virus-checker updates and media players.

In 2004, Tim Berners-Lee, the inventor of the web, received a knighthood. He is reported as saying 'There was a time when people felt that the Internet was another world, but now they realise it's a tool we use in this one'. Further parts of this series will show just how useful a tool the Internet can be.

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