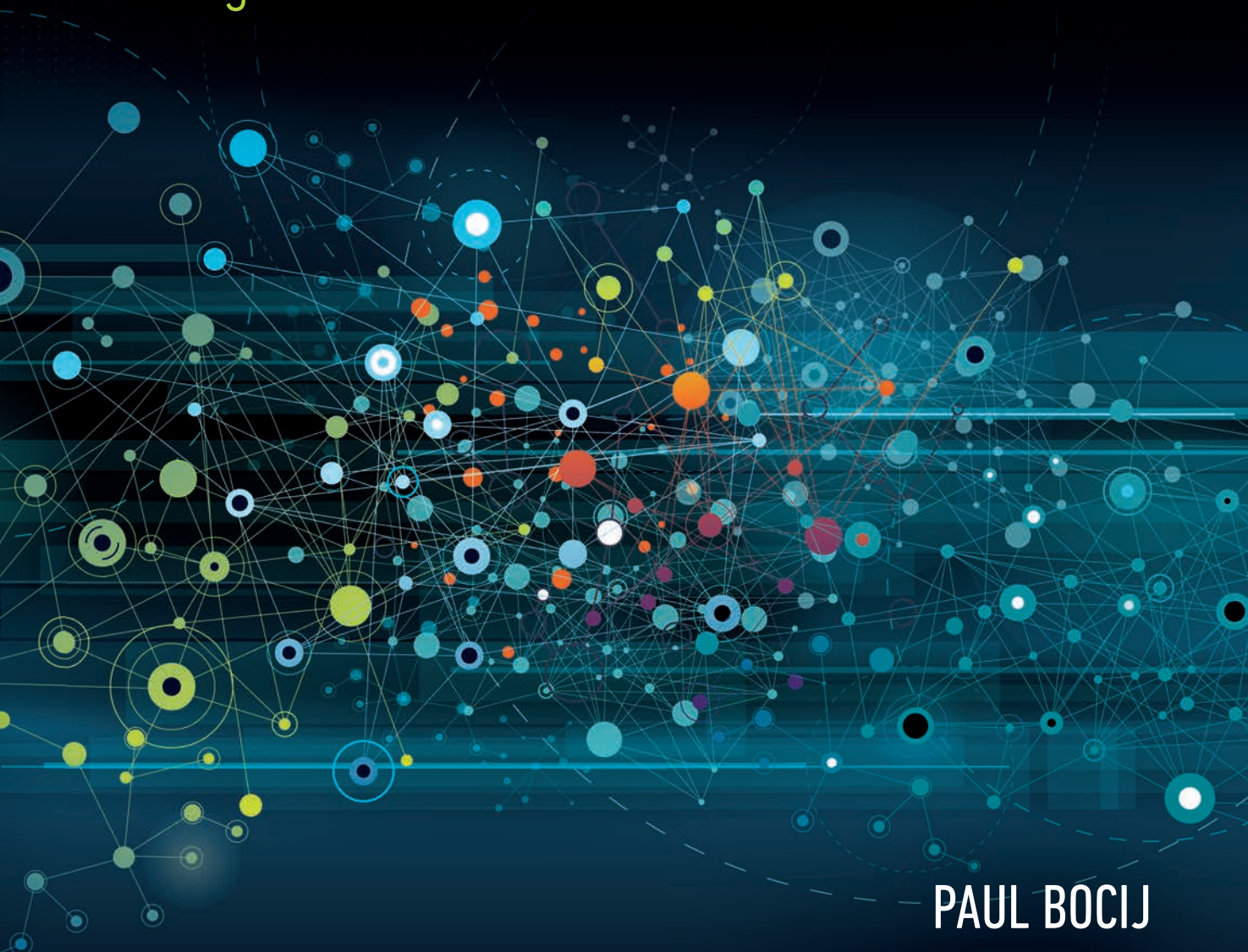
BUSINESS INFORMATION SYSTEMS

SIXTH EDITION

Technology, development and management for the modern business



PAUL BOCIJ
ANDREW GREASLEY
SIMON HICKIE

Pearson

Business Information Systems

wireless infrared transmission from desktop or laptop computers that do not need to be connected to the printer.

- *Wireless transmission* can also be used locally to form a wireless LAN. Here a microwave or narrowband radio transmitter and receiver may be used to connect different buildings. Wireless LANs are often used across college campuses. They have the benefit that the cost of laying cabling is not incurred. This makes them particularly suitable where it is not clear whether a link is needed in the long term.
- *Microwave transmission* can be used to beam information through the atmosphere. The maximum distance that can separate microwave transmitters is 45 km, since the signal follows a straight line and the curvature of the earth limits transmission distance. This can make microwave an expensive method of transmitting data, but the cost can be reduced if it is combined with satellite methods.
- *Satellite transmission* operates at two orbit levels: high orbit at 22,300 miles (36,000 km) in a geostationary orbit and at a lower orbit. Messages are sent from a transceiver at one location on the earth's surface and are bounced off the satellite to another transceiver. Because of the distances involved, this can give a time delay of up to a quarter of a second, which is evident in interviews conducted by satellite. A range of frequencies can be used. Satellite applications include television, telephone and data transmission.
- Both guided and unguided media use a number of transmission schemes such as OFDM in order to improve their efficiency. **Orthogonal frequency-division multiplexing (OFDM)** is used in applications such as digital television and audio broadcasting, wireless networking and broadband Internet access.

Orthogonal frequency-division multiplexing (OFDM)

A technique used for transmitting data over guided and unguided media.

Network operating systems

The final component that is needed to make all the other components work in unison is a **network operating system (NOS)**. This is systems software necessary to control the access to and flow of information around a network and provides the following functions:

Network operating system (NOS)

The software necessary to control the access to and flow of information around a network.

- access control or security through providing user accounts with user names and passwords;
- file and data sharing of data stored on a database server or file server;
- communications between users via e-mail, diary systems or workgroup software;
- sharing of devices, enabling, for example, the backup to tape of data on the server, or printer sharing.

The most widely used NOS for a PC-based LAN were Novell Netware and IBM LAN Manager. However, NOS features are now built into standard operating systems such as Microsoft Windows, and this has been adopted by companies. For Unix-based servers the NOS is a component of the operating system. Unix is used by many medium and large companies operating servers from companies such as Oracle Corporation, Hewlett Packard and IBM. It is often thought to offer better stability than Windows NT since it is a long-established NOS.

NETWORK TYPES

This section describes a variety of network types that cater for short-range, medium-range and long-range communications implemented using guided and unguided media.

Personal-area networks (PANs)

Bluetooth
A wireless standard for transmission of data between devices over relatively short ranges (normally less than 100 metres).

A personal-area network (PAN) can be implemented using the **Bluetooth** wireless technology. Bluetooth is used for short-range data transmission between devices and thus can be used to create a small-scale network. Bluetooth is the popular name for the 802.15 wireless networking standard defined by the Institute of Electrical and Electronics Engineers (IEEE). Applications of Bluetooth include wireless keyboards and beaming data between a tablet and a desktop or a laptop and a printer. A popular application of Bluetooth which makes use of its low power needs is the use of wireless headphones. Transmission distances between Bluetooth-enabled devices were initially limited to 10 metres, but now is typically up to 100 metres, so there is now the option for using the technology for networking like Wi-Fi. Bluetooth 2 offers transmission speeds of up to 3 Mbps, Bluetooth 3.0 (introduced in 2009) offers 24 Mbps and Bluetooth 4 was introduced in 2010. Bluetooth 5 was introduced in 2016 with a maximum speed of 50 Mbps and a maximum range of 240 metres.

It has been suggested that use of Bluetooth for business purposes represents a security risk through a process known as 'bluesnarfing'. An example of this often referred to is that, if you so wished, you could go to an airport passenger lounge and scan the diaries or contacts on passengers' different laptops, phones or tablets.

Local-area network (LAN)

Local-area network (LAN)
A computer network that spans a limited geographic area, typically a single office or building.

A **local-area network (LAN)** consists of a single network segment or several connected segments that are limited in extent, hence local. A network segment defines a group of clients that are attached to the same hub or network interface card linked to a single server. The term 'local' can be interpreted in different ways. LANs are usually limited to a company occupying a single building, but could equally connect several buildings across a larger company site. Faster, higher-capacity links such as fibre-optic cables connecting different LANs or network segments are sometimes referred to as 'backbones'. Such networks may just have a single server if the company is of fewer than, say, 20 people. Larger companies with hundreds of employees are very likely to have several central servers and possibly departmental servers also. A LAN is used to share computer resources between different members of a company or workgroup. For example, a printer sharer allows several computers to be attached to a single printer, thus reducing costs. Manual printer sharers are controlled by turning a dial to indicate which computer will be used to send data to the printer. Automatic printer sharers detect any data sent to the printer and configure themselves accordingly.

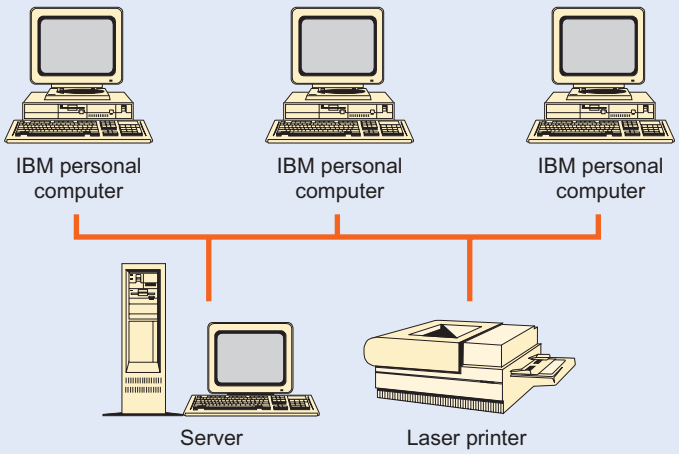
A simple network that links three PC workstations with a shared server and printer is shown in Figure 5.3. This is an example of a LAN that might serve a workgroup or a small company. Here the computers and the printer are the main components of the network, with the cables and network cards forming other components. We will explain servers in more detail later. For now, consider them as a more powerful computer that is used to store data and help the other PCs communicate. The final component needed to make the network function, which is not shown on the diagram, is the communications software that enables all the components to work together.

A small-scale or workgroup network gives the following benefits by enabling:

- workers to share common information which is typically stored on the server;
- communications between workers, perhaps through e-mail or a shared diary system;
- sharing of various facilities such as printing, hard disk storage or software applications on the server.

The capability to share devices and applications also gives the additional major benefit of cost reduction.

Figure 5.3 A small workgroup network connecting a single server to three PCs and a laser printer



Wi-Fi ('wireless fidelity')

A high-speed wireless local-area network enabling wireless access to the Internet for mobile, office and home users.

Wi-Fi is the shorthand often used to describe a high-speed wireless LAN. Most Wi-Fi networks use a standard IEEE protocol known as 802.11a, b or g. The 802.11a variant offers speeds up to 54 Mbps at 5 GHz. The 802.11b and 802.11g variants both operate at a frequency of 2.4 GHz and are thus compatible; 802.11b offers speeds up to 11 Mbps and 802.11g offers speeds up to 54 Mbps. The 802.11n standard aims to achieve transmission speeds above 100 Mbps and the 802.11ac standard aims to deliver speeds above 500 Mbps.

Wi-Fi is widely deployed in an office or home environment where it removes the need for cabling and adds flexibility. Note that this increased usage has security limitations since Wi-Fi encryption is limited and communications can potentially be intercepted or 'sniffed' by anyone in the vicinity with appropriate scanning software.

For WLANs additional hardware is needed. For example, home users need to buy a wireless router (sometimes with firewall software included) which connects to the Internet and shares the Internet and local network access with all PCs in the house which contain wireless cards to receive the signal. Other devices can also be used; for example, music or video streamed from the Internet can be played on appropriate devices. Transmission is limited in home applications to around 100 m line of sight.

Hotspot

An access point positioned in a strategic spot in a public place to provide wireless coverage for a specific area.

Hotspots consist of access points positioned in a strategic spot in a public place to provide wireless coverage for a specific area. This allows employees and customers to access to the Internet from their laptops or other mobile devices without the need to connect using a wire. In 2014 it was estimated that over 42,000 public Wi-Fi hotspots were available in the UK (www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/infrastructure-2014).

Layouts for a local-area network

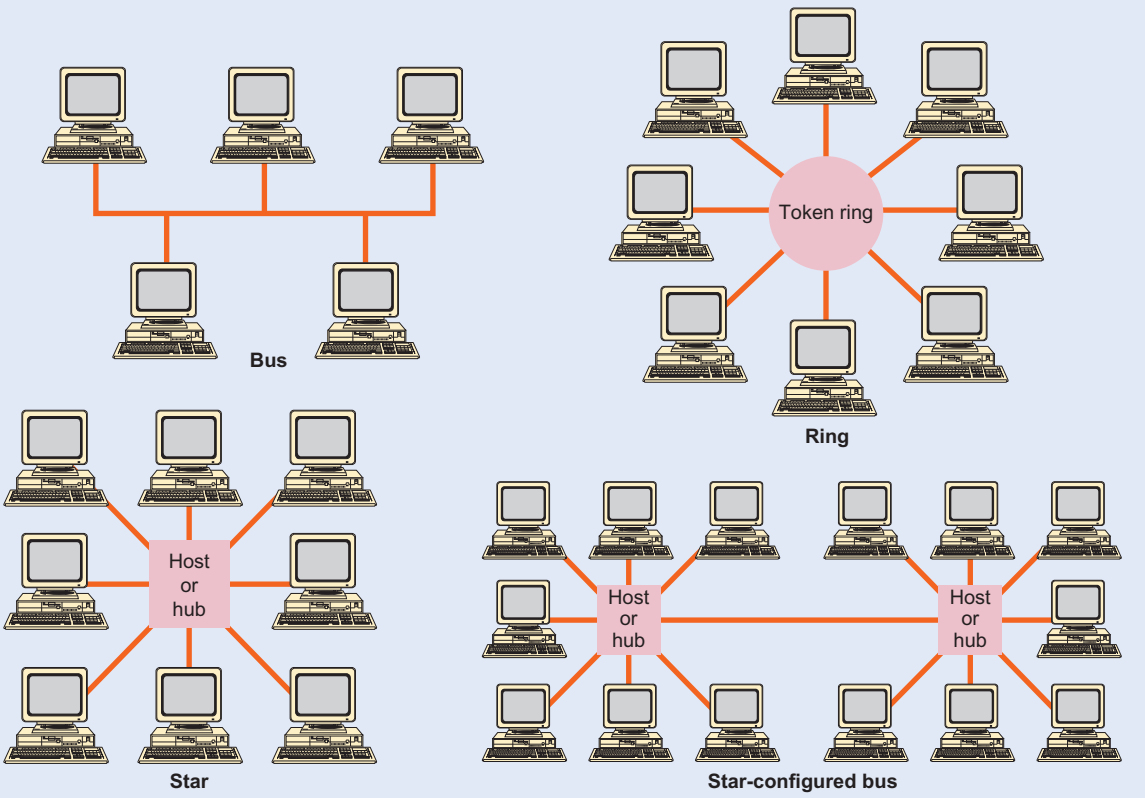
Network topology

The physical layout of a LAN is known as a network topology. Bus, star, ring and combinations are most common.

The physical layout of a LAN is known as a **network topology**. Bus, star, ring and combinations are most common.

There are a number of different arrangements for connecting the clients to the server in a LAN. These are known by the description of the layout or topology: bus, star or ring. The layouts of the arrangements are shown in Figure 5.4. When building a network for a company, the topology adopted will form part of the specification for the company performing installation of the network. The topology chosen and the media used to implement it will affect the network cost and performance, so these aspects are referred to in the description below. The advantages of the different types of topology are summarised in Table 5.3.

Figure 5.4 Local-area network topologies



Metropolitan-area network (MAN)

Metropolitan-area networks (MAN)

A metropolitan-area network (MAN) refers to a network covering a city or university campus.

Large cities such as London or New York often have a high-speed **metropolitan-area network (MAN)** to connect businesses within the city. Singapore has developed the concept of the 'intelligent island' in which businesses of the city are connected by a very high-speed network.

Table 5.3 Summary of the characteristics, advantages and disadvantages of the main LAN topologies

Topology	Characteristics	Advantage	Disadvantage
Bus or linear	Simple. Based on co-axial Ethernet cable, e.g. twisted-pair 10 Base-T	Easy to install and manage for small workgroup	Breaks in the cable disrupt the whole network
Star	Each PC is connected via a cable to a central location Each PC is not usually connected directly to the server, but via a hub	Provides protection from cable breaks	Dependent on central host
Ring	A continuous ring of network cable, e.g. token ring. The word 'token' refers to a packet of data which is passed from one node to the next	Suitable for large data volumes and mission-critical applications	Higher initial cost and time for installation

Metro Ethernet

A network covering a metropolitan area based on the Ethernet standard.

WiMax

WiMax is the name given to the IEEE 802.16 wireless standard which allows an access range of up to 30 miles (48 km) at speeds of up to 75 Mbps.

Wide-area network (WAN)

A network covering a large area which connects to businesses in different parts of the same city, different parts of a country or different countries.

A MAN can be implemented using a **Metro Ethernet** which is a network based on the Ethernet standard for computer communications over a network. Alternatively a MAN can be implemented using **WiMax** (Worldwide Interoperability for Microwave Access), which is the name given to the IEEE 802.16 wireless standard. WiMax can also be used for 'last mile' wireless broadband access as an alternative to cable connections.

Wide-area network (WAN)

These are large in extent and may connect offices in different parts of the same city, different parts of a country or even different countries (Figure 5.5). The **WAN** will connect many servers at each site. When we connect from a PC at one site to a server at another site, we talk about connecting to a 'remote' server across a WAN. If there is a large international coverage, it will be referred to as a 'global network'. If the WAN enables communications across the whole company, it is referred to as the 'enterprise network' or 'enterprise-wide network'. Companies usually pay for their own 'leased lines' or communications links between different sites. Virtual private networks and value-added networks, which are described later, provide cheaper alternatives where the communications links are shared.

Often the network used to connect remote sites is the public telephone, referred to as POTS or 'Plain Old Telephone System'. A company can also lease private or dedicated lines from a telecommunications supplier to connect sites, or can set up links using microwave or satellite methods.

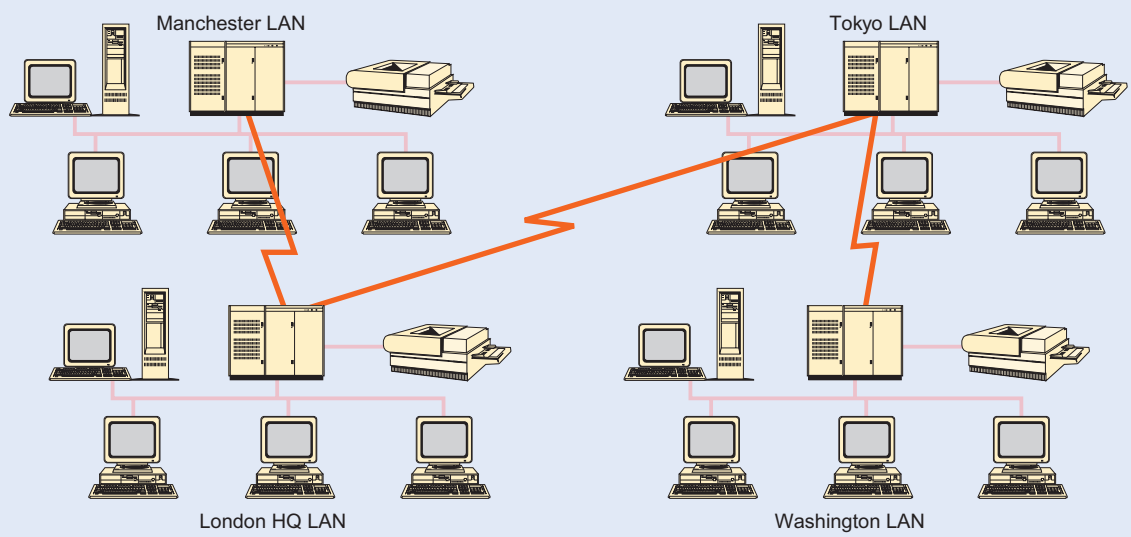
Value-added networks (VANs)

Value-added networks (VANs)

Value-added networks (VANs) give a subscription service enabling companies to transmit data securely across a shared network.

Value-added networks (VANs) are so named because they allow a company to minimise its investment in wide-area communications while still receiving all the benefits this can bring. The cost of setting up and maintaining the network is borne by the service provider, which then rents out the network to a number of companies. This works out more cheaply than if a company had leased its own point-to-point private lines, but it is not as secure.

Figure 5.5 A wide-area network (WAN)



Virtual private network (VPN)

A data network that makes use of the public telecommunications infrastructure and Internet, but information remains secure by the use of security procedures.

A similar concept to VAN is the **virtual private network (VPN)**. These are data networks that make use of the public telecommunications infrastructure and Internet, but information remains secure by the use of what is known as a 'tunnelling protocol' and security procedures such as 'firewalls', which are described later (in Chapter 15). A virtual private network can again be contrasted with a system of owned or leased point-to-point lines that can only be used by one company. Virtual private networks can be used in conjunction with wireless transmission such as 3G to enable remote workers such as sales representatives or teleworkers to access a company network and access customer databases and file servers, thus making them more productive by giving the information they need in real time.

Peer-to-peer networking

Peer-to-peer network

A simple type of local-area network which provides sharing of files and peripherals between PCs.

A **peer-to-peer network** is a simple type of LAN which provides sharing of files and peripherals between PCs. The same principle can be used on a larger scale – online music sharing systems are peer-to-peer.

'Peer-to-peer' refers to the capability of any computer on a LAN to share resources, in particular files and peripherals, with others. It is particularly appropriate for small workgroups where central control from a server is less necessary. Microsoft Windows provides these capabilities. For example, a user can, with permission, share across the network a file stored on another user's hard disk. With a peer-to-peer arrangement, data will be distributed and therefore difficult to back up and secure.

THE INTERNET

What is the Internet?

The Internet

The Internet refers to the physical network that links computers across the globe. It consists of the infrastructure of network servers and communications links between them that are used to hold and transport information between the client PCs and web servers.

Internet service provider (ISP)

A provider enabling home or business users a connection to access the Internet. The ISP can also host web-based applications.

Backbones

High-speed communications links used to enable Internet communications across a country and internationally.

The **Internet** allows communications between millions of connected computers worldwide. Information is transmitted from client PCs whose users request services to server computers that hold information and host business applications that deliver the services in response to requests. The Internet is a large-scale client/server system. By March 2017 it was estimated that, worldwide, there were over 3.7 billion Internet users or about half of the world's population (www.internetworldstats.com/stats.htm). The client PCs within homes and businesses are connected to the Internet via local **Internet service providers (ISPs)** which, in turn, are linked to larger ISPs with connection to the major national and international infrastructure or backbones (Figure 5.6). In the UK, at the London Internet Exchange in the Docklands area of east London, a facility exists to connect multiple **backbones** of the major ISPs within the UK onto a single high-speed link out of the UK into Europe and through to the rest of the world. These high-speed links can be thought of as the motorways on the 'information superhighway' while the links provided from ISPs to consumers are equivalent to slow country roads.

A variety of end-user tools are available to exchange information over the Internet – web browsers and e-mail are the best known. As we will see in the next section, although the Internet has existed for around 30 years, it is only since the early 1990s, when the web browser was first widely adopted, that the use of the Internet by business has grown dramatically.

Development of the Internet

The simplest way in which the Internet can be described is as a global network system made up of smaller systems. The history and origin of the Internet as a business tool are