As a small-to-medium sized business expands, so does its NEED FOR NETWORKING. Dave Mitchell makes the link between growth and collaborative computing.

Altogether now

▼ STACKING HUBS IS AN IDEAL EXPANSION TECHNIQUE, AS NETWORK PERFORMANCE IS UNAFFECTED

The past year has seen most of the big names in the IT industry turning their mighty gaze on small businesses. Hardly surprising, since the SME (Small to Medium Enterprise) represents a huge proportion of businesses in the UK and has only recently begun to realise the potential benefits that IT has to offer. One of the key areas being focused on by the major manufacturers is networking, and many vendors have created complete product lines specifically aimed at helping the small business take its first steps on the road to collaborative computing. The key to choosing the right products is understanding the needs of your business and its potential for expansion. Networks have a knack of growing beyond all expectations, so the hardware you buy today needs to be able to grow with your company.

The most common starting point for many small businesses is the peer-to-peer network: a small group of PCs connected over an ethernet network, sharing resources such as hard disks, CD-ROMs and locally attached printers. They'll usually have their network interface cards (NICs) connected over 10Base-2 cabling, or thin ethernet. The main advantages are the low cost of setup, as the 50-ohm co-axial cable is relatively cheap, and the PCs can be connected directly to the cable using T-connectors.

But thin ethernet does have its limitations and is consequently losing favour. The co-axial cable represents a single point of failure. If a break occurs anywhere along its length, communication between all connected PCs will be lost, and due to the lack of any status indicators, troubleshooting can be extremely difficult. Plus, the maximum cable length for a network segment is 185m, which can only support up to 30 workstations.

Return to Base-T

The most popular form of network connection is over UTP (unshielded twisted pair) cable, commonly referred to as 10Base-T. The cable contains two pairs of twisted wires: one pair used for transmitting, the other for receiving. Each wire twist is through 180° to cancel out electromagnetic interference (EMI) while leaving the signal intact. The wire in between each twist
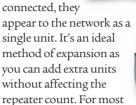
can act as an antenna and receive noise, so cable lengths are limited to 100m. To ensure transmission quality is maintained, the signal needs to be regenerated, and this is carried out by the ubiquitous repeater, or hub.

Introducing a hub onto a network changes the topology (structure) of it. Thin ethernet creates a bus topology where the co-axial cable is laid out in a single branch with workstations connected along its length. A hub creates a star topology where the hub is the central point with all connection radiating outwards. True, the hub itself now represents a single point of failure which can affect the entire network, but hub failures are extremely rare.

To allow distances between workstations to be increased beyond 10Base-T cable segment limitations, more hubs can be connected to ports on the first hub. Called cascading or daisy-chaining, one port on each hub is used to connect the two devices together. A special cable, with the send and receive wires crossed over, may be required but most hubs have a dual-function port. It can function as a normal port, or, with the flick of a switch, become a crossover port allowing a standard straight-through cable to be used to link a second hub.

There's no limit to the number of hubs which can be in a cascade, but, as signal quality and timing cannot be maintained beyond a certain point, no two end-stations can be separated by more than four hubs or five wiring segments. This could be a potential problem to companies that have used up all available ports on their hubs and want to expand further without violating these connection rules.

The simple solution is a stackable hub. It has a special connector on the rear panel allowing its backplane to be linked directly to another hub. When two or more are connected, they appear to the network as a single unit. It's an ideal method of expansion as you can add extra units without affecting the repeater count. For most small companies with users swapping the occasional file and using shared printers, standard 10Mbits/sec ethernet will provide all the bandwidth they need. However, the amount and variety of data being shunted around today's networks can soak this up, so the next option is Fast Ethernet. It's got the same look and feel as standard ethernet, the only difference being bit timings (the time taken for each bit of information to be transmitted). These have been reduced by a factor of ten, thus giving a ten-fold increase in performance to 100Mbits/sec.

The faster alternative

Fast Ethernet products are now cheap enough to be a viable alternative to standard ethernet. Dual-speed network interface cards can be had for a modest extra outlay, and many hubs, even at the small-business level, support both 10 and 100Mbits/sec connections. These use two separate internal backplanes for dealing with the different connection speeds.

Are there rules for Fast Ethernet? You bet there are. Only two repeaters can be placed

▲ **LEDs** ON THE FRONT OF HUBS, SUCH AS THESE INTEL MODELS, INDICATE THE STATE OF NETWORK ACTIVITY

CHEAP NETWORK HUBS

▲ **Bay Networks NetGear E104TP** (£25 ex VAT). Basic four-port 10Base-T hub. One port can be converted to crossover for hub cascading. It uses an external power supply. The E104 costs £38 (ex VAT) and is the same as the E104TP but with an extra BNC connector for connecting to other hubs over a 10Base-2 co-axial backbone cable.

▼ **Intel InBusiness 5-port hub** (£38 ex VAT). Attractively designed five-port 10Base-T hub. Its casing allows extra hubs to be clipped together and one port can be used as a crossover for cascading. An eight-port version (£47 ex VAT) is also available.

▶ **3Com OfficeConnect Hub 8/TPC** (£75 ex VAT). This is a well-built, eight-port 10Base-T hub. There's a useful collection of status lights on the front panel and an extra BNC connector for connecting to 10Base-2 backbone. The Hub 8/TPO version has no BNC connector and costs £59 (ex VAT). Fast Ethernet hub prices start at around £105 for the four-port OfficeConnect TP400.

• **UmaxSOHO-10H05** (£32 ex VAT). A five-port 10Base-T hub with an extra crossover port for cascading. The eight-port version (pictured, right: £49 ex VAT) also has one BNC socket for backbone connection.

between workstations and the total cable length across the entire link must be 205m. The cable grade you choose is also important. If you install a standard ethernet network and use cheap Category 3 cable, you won't be able to migrate your users to Fast Ethernet as the cable is not of a sufficiently high quality to handle the faster signals. It's far safer when specifying your wiring to choose Category 5 cable.

One of the biggest issues is maximum throughput, whether it's ethernet or Fast Ethernet. Essentially, ethernet is a connectionless service over shared media. When data is transmitted, it is sent to every other node on the network and only one packet of data can be on the wire at any one time. If two packets are transmitted simultaneously, they'll collide, so each station must back off for a specific time and then re-transmit.

Ethernet networks use a method clumsily called Carrier Sense Multiple Access/Collision Detection (CSMA/CD) to deal with the collision problem. Unfortunately, as more data is transmitted, the likelihood of a collision occurring increases and eventually the network can reach a stage known as thrashing: there are so many colliding transmissions that no data is getting through to its destination. This usually occurs at around 80 percent utilisation of the available bandwidth.

While Fast Ethernet solves this problem by throwing more bandwidth at it, a switch is another alternative. It looks no different to a hub, but all similarity ends there. Switches contain powerful processors and memory that allow them to read and store the addresses contained in each frame's header. When a transmission occurs between two nodes, the addresses are stored in a forwarding table held in memory, allowing the switch to "remember" which physical port each node is connected to. When further frames are received, they can be switched only to the port where the destination node is located, thus reducing network traffic as

NETWORK STARTER KITS

You've decided to get your office PCs connected but don't want the hassle of buying the network components separately. Why not go for a complete network starter kit? Aimed at the SoHo (small office/home office) market, these provide all the necessary components to get your first network up and running with the minimum of fuss, and offer good value. Here we look at three different kits.

☛ **The OfficeConnect starter kit from 3Com** costs £81 (ex VAT) and contains all you need to get two or more PCs networked. It comes with a brace of 10Base-T network cards, a four-port hub and two generous 7.6m lengths of Category 5 UTP cable. One of the ports doubles as a crossover port, so if you want to cascade further hubs you'll lose one of the four-ports. Remember the ethernet four-repeater rule,

so your network will be limited to supporting 12 end-stations if you only use four-port hubs. If that's enough, you'll find this kit easy to set up thanks to the superb documentation. The ISA NICs look slightly dated considering everything's moving over to PCI, but they can easily handle the demands of a standard ethernet network.

☛ **Check out Accton's Network Starter Kit** if you want to bypass standard ethernet completely by choosing a Fast Ethernet-only solution. For £129 (ex VAT) you get a couple of PCI dual-speed network cards, a four-port Fast Ethernet hub and two 4.5m Category 5 UTP cables. The Accton CheetaHub Power-3004D hub has a small slide-on baseplate allowing it to be mounted just about anywhere. Plenty of status lights show you what each connected

workstation or server is up to, plus a couple of bandwidth utilisation lights. The network cards have driver support for DOS, Windows 3.x, Windows 95/98 and Windows NT, and there's a comprehensive instruction sheet. The main points to remember with this kit are that you won't be able to connect any standard 10Mbits/sec ethernet products to the hub as it is not dual-speed, and Fast Ethernet rules dictate that only one more hub can be cascaded, so this starter kit limits you to a maximum of eight ports. You can, however, cascade

using a larger hub with more than four ports.

☛ **RingDale's starter kit** offers a similar package to Accton's (*p142*). Its starter kit includes a couple of Novell dual-speed NICs, two Category 5 cables and a four-port Fast Ethernet hub. At around £399 (ex VAT) it's comparatively expensive but you also get a Fast Ethernet print server. This little box of tricks allows you to connect any printer to the network as it has a parallel port at one end and a network port at the other.

transmissions are not being propagated across the entire network. The switch creates a virtual connection between the sending and receiving addresses, and segments the network into smaller collision domains. Implementing a switch doesn't mean your hubs have to go, as they can be linked directly to the switch ports. Performance will be boosted because the groups of users connected to each hub will now receive a dedicated 10 or 100Mbits/sec pipeline.

Small-business selection

When purchasing your network hub or switch, you'll find a huge range of products at competitive prices. For the small office there are network kits and we've reviewed three of them in the panel "Network Starter Kits" on page 140.

☞ **Check out Bay Networks' NetGear** range of products if you want to network a small business or home office and are looking for a hub with more than four ports. For £35 (ex VAT) you can get an **EN106TP** six-port hub or risk just £40 (ex VAT) for the **EN108TP** eight-port version. Either way you'll get a basic 10Base-T hub sheathed in a solid metal shell, with a lifetime warranty. Each port has status lights so you can see at a glance if there are any problems, and a dual-function port allows you to cascade.

☞ **Compaq can help,** if you want the best of both worlds, with its latest **HB3120** dual-speed hub. For £240 (ex VAT) you get eight autosensing ports that run at either 10 or 100Mbits/sec, depending on the connection the hub detects. The front panel provides plenty of LED-based diagnostic information, along with individual port status and operating speed. The HB3120 stacks a maximum of six units so you can go up to 48 ports without affecting the repeater count. You could add an **HB3220** for £300 (ex VAT), which uses an internal switch to link the 10 and 100Mbits/sec backplanes in the entire stack for full dual-speed switching.

☞ **Accton has always had** a strong presence in the small-business networking market and its latest **CheetaHub Power-3524A** has a few tricks to make it stand out from the crowd. In its most basic form it's a 24-port dual-speed stackable hub costing a reasonable £559 (ex VAT). One dual-function port allows you to cascade another hub, or you can stack up to six CheetaHubs together using the rear backplane connectors for a massive 144 ports, without increasing the repeater count. A wide array of

status lights keeps you in touch with the action and shows the speed at which each port is operating. Two expansion slots on the front panel allow a variety of modules to be added. The most interesting is the **EM-3560** module. Slot this in, and your dual-speed stackable hub is transformed into a switch for an extra £169 (ex VAT). The module has its own on-board processor and enough memory to store up to 4,096 different network addresses.

☞ **InBusiness hubs and switches represent Intel's move,** last year, into the small-business market . You can move straight into 10Mbits/sec ethernet switching for £250 (ex VAT) with the eight-port **Switch Plus**, a diminutive plastic box with eight switched 10Base-T ports at the rear. More units can be slotted together to form a physical stack but connection is via an additional crossover port, and extra units will increase the repeater count. Two more dual-speed ports allow the Switch Plus to be connected to another Fast Ethernet hub or you can use them to provide a fast pipeline to network servers.

☞ **SMC's TigerSwitch 6724** is at the high end of the switch market. At £1,275 (ex VAT) it seems expensive but comes as standard with 24 dual-speed, auto-sensing ports and has enough internal memory to automatically read and store 8,000 network addresses. You can link a serial cable to a connector on the front panel and use a terminal emulation session on a PC to view and modify switch settings and monitor performance.

Alternatively, by assigning an IP address to the TigerSwitch, it can be managed from a workstation anywhere on the same network using a standard web browser.

What type of networking technology and equipment you choose should be determined clearly by your type of business and user requirements. The golden rule with networking is to plan carefully before taking that first step. With solid foundations in place, you can expand your network as demand grows. Get it right, and your business will benefit from increased productivity and reduced costs.

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