Dual-speed Ethernet switches

Dave Mitchell rounds up the latest machine room workhorses

Ethernet is a remarkable technology. Despite being introduced some 30 years ago, it's so resilient and adaptable that it has grown to become the dominant networking technology with an estimated 100 million interfaces installed worldwide. And, just when it looks like it's about to run out of steam, along comes the next standard and a corresponding ten-fold speed increase.

Shared Ethernet still holds sway in the workgroup and small business sector, but switched Ethernet is rapidly eroding this lead. Research last year by network intelligence specialist Rhetorik showed that investment in Ethernet switching technology at the workgroup level rose by 21 per cent from 2001, and that the workgroup user base for these products had increased by 9 per cent. This isn't surprising, as prices for switched Ethernet products have fallen so rapidly that they offer a highly cost-effective method of boosting network performance.

In this month's group test, we take a look at 12 switched Ethernet products suitable for the workgroup and small to medium-sized business. Features are improving with little impact on cost, so we stipulated that each product has a minimum of 24 10/100BaseTX ports and be fully manageable. We also wanted a helping of Gigabit Ethernet on the side with a minimum of two 1000BaseT copper Gigabit uplink ports. This high-speed Ethernet technology has also dropped dramatically in cost per port, and even as far back as the end of 2001 surveys carried out by Rhetorik identified a doubling in the installed base, with it accounting for over 12 per cent of UK backbone technologies.

So what makes a switch so special? Physically, Ethernet switches are similar to hubs but contain powerful processors, custom-built ASICs (application specific integrated circuits) and memory that allows them to read and store the MAC (media access control) addresses contained in each frame's header. The first time a transmission occurs between two networked devices, the switch reads each frame's source and destination addresses and stores them in a forwarding table. As it now knows which port the source and destination devices are connected

to, any further transmissions addressed to them will be forwarded only to those ports. The switch is effectively creating a virtual connection between the two devices and is also automatically segmenting the network into smaller collision domains. Having multiple collision domains can have an immediate effect on network performance as each segment has reduced traffic, resulting in fewer collisions.

Besides the obvious performance benefits, there are numerous other features making switches a more popular choice. Many companies now consider support for VLANs (virtual LANs) to be an important factor. VLANs are software-based and allow devices that are physically on different network segments to access each other as though they were on the same wire. The most basic type is the port-based VLAN, which allows administrators to place specific ports into groups so only members physically connected to these ports can see each other.

> **The minimal cost implications of switched Fast Ethernet means it can be easily deployed down to the desktop where users will benefit**

Further control is offered by 802.1q VLANs, which require a special tag inserted into each frame that is used by the switch to determine which VLAN a user belongs to. Note, however, that all network devices participating in this type of VLAN must support the 802.1q specification, and this includes workstation network adaptors.

All the switches on review offer a range of other key features, including port trunking for fault-tolerant switch-to-switch links and QoS (Quality of Service) using 802.1p packet prioritisation. Some also feature basic Layer 3

routing capabilities, while others can be placed in a stack with other units and managed as a single virtual switch with one IP address. Used by switches to spot network failures and route around them, 802.1d STP (spanning tree protocol) is now looking overly slow, but the new 802.1w standard aims to improve network recovery speed. Although there's limited support at the moment, security also gets a boost with 802.1x port-based access control. This allows security to be implemented the moment a user plugs in a cable, as the switch won't allow access to the network until it receives a valid username and password.

Naturally, with all these tools on offer a good management interface is essential and so web-based remote management is also becoming a big factor in any buying decision. A brush with the CLI (command line interface) over a terminal emulation session is almost a certainty and the ease with which this can be used varies dramatically across different vendors. Fortunately, all but one of the switches have internal HTTP servers, so you only need to use the CLI to assign the switch an IP address and then you can remotely manage the switch over the Net and an intranet using a standard web browser.

It's clear that the future for Ethernet looks rosy. Gigabit and 10Gigabit Ethernet are realities, while 40- and 100Gigabit standards are in the pipeline, so further expansion options are almost limitless. The minimal cost implications of switched Fast Ethernet means it can be easily deployed down to the desktop where users can benefit from reduced waiting time even for simple tasks such as file copies.

Is your company switched on yet? If not, you'll find plenty of information over the page to help make an informed buying decision.

ENTERPRISE
Ethernet switches

● FEATURE TABLE

	3Com SuperStack 3 Switch 4226T	Allied Telesyn AT-8350GB	Avaya P133GT2	Cisco Systems Catalyst 2950T-24	Comet Labs GSR224T	Dell PowerConnect 3024	D-Link DES-3250TG	Enterasys Matrix E1 1H582-51
Overall rating	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★
Price (inc VAT)	£663 (£779)	£1,213 (£1,425)	£1,235 (£1,451)	£795 (£934)	£299 (£351)	£464 (£545)	£880 (£1,034)	£4,450 (£5,229)
Supplier	3Com 01442 438000	Allied Telesyn 0118 920 9800	Avaya 0800 698 3619	Cisco Systems 020 8824 1000	Comet Labs 020 8332 1277	Dell 0870 152 4699	D-Link 020 8731 5555	Enterasys Networks 01635 580000
Manufacturer's website	www.3com.co.uk	www.alliedtelesyn.com	www.avaya.com	www.cisco.com	www.cometlabs.com	www.dell.co.uk	www.dlink.co.uk	www.enterasys.com
Warranty	Limited lifetime RTB	3yrs NBD swap-out	Limited lifetime RTB	Limited lifetime RTB	5yrs RTB	1yr NBD swap-out	Limited lifetime NBD swap-out	1yr RTB
CHASSIS								
No. of fixed ports/speeds	24 x 10/100BaseTX 2 x 10/100/1000BaseT	48 x 10/100BaseTX 2 x 10/100/1000BaseT 2 x GBICs	24 x 10/100BaseTX 2 x 100/1000BaseT	24 x 10/100BaseTX 2 x 100/1000BaseT	24 x 10/100BaseTX 2 x 10/100/1000BaseT	24 x 10/100BaseTX 2 x 10/100/1000BaseT	48 x 10/100BaseTX 2 x 10/100/1000BaseT	48 x 10/100BaseTX
Expansion slots	✗	1	✗	✗	✗	GBICs (2)	SFP GBICs (2)	3
Expansion modules (ports)	✗	1000BaseT (2) 100BaseFX (2)	✗	✗	✗	✗	✗	10/100BaseTX (16) 1000BaseT (2) 100BaseFX (8) GBIC (2)
Auto MDI/MDI-X ports	All	All	All	All	All	All	All	All
STACKING								
Physical (no. of units)	✔ (4)	✔ (3)	✔ (4)	✗	✗	✔ (6)	N/A	✗
Virtual (no. of units)	✗	✗	✗	✔ (16)	✗	✗	N/A	✗
Stacking cables supplied	✗	✔	✗	N/A	N/A	✔	N/A	✗
Redundant PSU option	✔	✔	✗	✔	✗	✗	✗	Included
Forwarding mode	Store-and-forward	Store-and-forward	Store-and-forward	Store-and-forward	Store-and-forward	Store-and-forward	Store-and-forward	Store-and-forward
Maximum bandwidth (Gb/sec)	8.8	32	8.8	8.8	9.6	12.8	13.6	24
MAC address capacity	8,000	8,000	8,000	8,000	1,000	8,000	8,000	64,000
Layer 3 routing	✗	✗	✗	✗	✗	✗	✗	✔
Layer 4 switching	✗	✗	✗	✗	✗	✗	✗	✔
Port mirroring	✔	✔	✔	✔	✔	✔	✔	✔
Port trunking	✔	✔	✔	✔	✔	✔	✔	✔
802.1d STP	✔	✔	✔	✔	✔	✔	✔	✔
802.1w RSTP	✗	✗	✗	✔	✗	✗	✗	✔
802.1p prioritisation	✔	✔	✔	✔	✔	✔	✔	✔
802.1x port access control	✗	✗	✗	✔	✗	✗	✗	✔
VLAN SUPPORT								
No. of VLANs	60	256	62	64	6	256	255	4,094
Port based	✔	✔	✔	✔	✔	✔	✔	✔
Address based	✗	✗	✗	✔	✗	✗	✗	✗
IEEE 802.1Q	✔	✔	✔	✔	✔	✔	✔	✔
Other	✗	✗	✗	✗	✗	✗	✗	✗
GVRP	✗	✔	✗	✔	✗	✗	✗	✔
MANAGEMENT								
Out-of-band management	Serial	Serial	RJ-45	RJ-45	Serial	Serial	Serial	RJ-45
PORTS								
CLI	✔	✔	✔	✔	✔	✔	✔	✔
Telnet	✔	✔	✔	✔	✗	✔	✔	✔
Web browser	✔	✔	✔	✔	✗	✔	✔	✔
SNMP	✔	✔	✔	✔	✗	✔	✔	✔
Other	Network Supervisor (optional)	AT-ViewPlus (optional)	Avaya Policy Manager (optional)	Visual Switch Manager	✗	✗	D-View (optional)	✗

How we test

To give each switch a thorough workout, we call in the SmartBits SMB-6000B Multiport tester. Our thanks go to Spirent Communications for supplying a chassis fitted with four six-port LAN-3101A cards for a total of 24 10/100BaseTX ports and a pair of LAN-3300A cards, giving us four 1000BaseT ports. Used by many switch manufacturers for in-house testing on new networking products, the SmartBits is recognised and respected throughout the industry as one of the most sophisticated test systems available.

In previous switch tests, we concentrated on local switching capabilities across all dual-speed ports, but as one of our requirements is the inclusion of Gigabit Ethernet ports we based our first test on uplink performance. Using the SmartFlow frame loss test, we create a backbone port setup comprising 24 10/100BaseTX

ports on one side and two 1000BaseT ports on the other. The frame loss test is set up to fire packets at a 100 per cent traffic load from all the dual-speed ports across to both Gigabit Ethernet ports. The test is conducted for both 64-byte and 1,518-byte frames – the standard minimum and maximum Ethernet frame sizes.

This test is attempting to squeeze a quart into a pint pot, as frame loss is going to occur no matter how good the switch. With all ports operating in full-duplex mode, we're trying to force 4.8Gb/sec into two ports that can only handle a maximum 4Gb/sec throughput. All manufacturers claim their products operate at wire speed, so if the switch is functioning as quoted the test will show a loss of 16.67 per cent at the full traffic load. Overall, we found the majority of switches delivered on this promise.

When the tests are started, the SmartBits sends learning packets to each port on the switch so it can load its forwarding table with MAC addresses. The test duration is set to 30 seconds, after which SmartFlow creates a full report, analysis

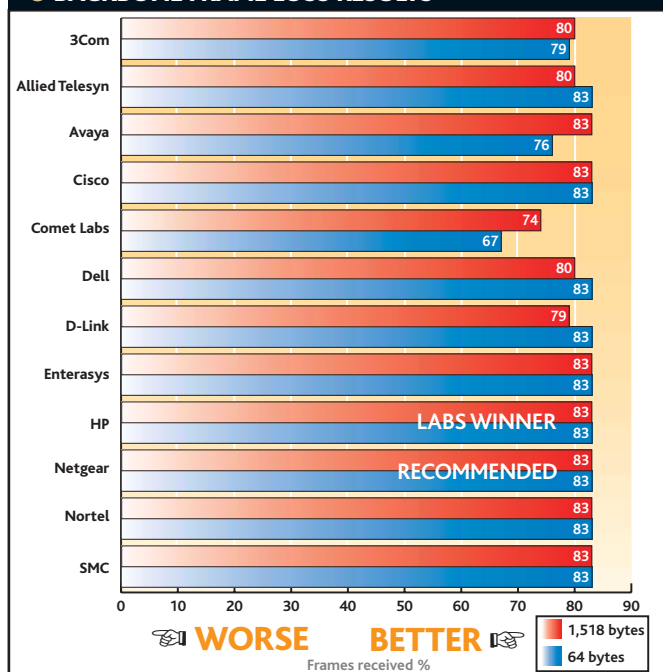|	HP ProCurve switch 2650	Netgear FSM726S	Nortel Networks Business Policy Switch 2000	SMC TigerSwitch SMC6750L2
	★★★★★☆	★★★★★☆	★★★★☆☆	★★★★☆☆
	£1,175 (£1,381)	£582 (£684)	£2,769 (£3,254)	£899 (£1,056)
	Hewlett-Packard 0870 240 2479	Netgear 01344 397021	Nortel Networks 01628 432000	SMC Networks 01932 866553
	www.hp.co.uk	www.netgear.co.uk	www.nortelnetworks.com	www.smc.com
	Limited lifetime NBD swap-out	5yrs NBD swap-out	Limited lifetime RTB	5yrs RTB
	48 x 10/100BaseTX 2 x 10/100/1000BaseT	24 x 10/100BaseTX 2 x 10/100/1000BaseT	24 x 10/100BaseTX	48 x 10/100BaseTX 2 x 10/100/1000BaseT
	SFP GBICs (2)	GBICs (2)	2	SFP GBICs (2)
	✗	✗	10/100/1000BaseT (1/2) SFP GBICs (2)	✗
	All	All	All	All
	✗	✔ (6)	✔ (8)	✗
	✔ (16)	✗	✗	✗
	N/A	✔	✗	N/A
	✗	✗	✔	✔
	✗	Store-and-forward	Store-and-forward	Store-and-forward
	13.6	12.8	Not stated	13.6
	8,000	8,000	16,000	8,000
	✗	✗	✔	✗
	✗	✗	✔	✗
	✔	✔	✔	✔
	✔	✔	✔	✔
	✔	✔	✔	✔
	✔	✗	✗	✗
	✔	✔	✔	✔
	✔	✗	✗	✗
	30	256	256	255
	✔	✔	✔	✔
	✗	✗	✔	✗
	✔	✔	✔	✔
	✗	✗	Protocol	✗
	✔	✗	✔	✔
	Serial	Serial	Serial	Serial
	✔	✔	✔	✔
	✔	✔	✔	✔
	✔	✔	✔	✔
	✔	✔	✔	✔
	HP TopTools	✗	Nortel Optivity (optional)	EliteView

and graphs showing the percentage of forwarded frames lost.

Our second test compares the speed of each switch's backplane. SmartFlow measures latency for 64-, 512-, 1,024- and 1,518-byte frame sizes. This determines the time it takes for frames to traverse the switching fabric in microseconds while the switch is under a full load. The test is run across all 24 dual-speed ports. SmartFlow measures average latency midway through each run.
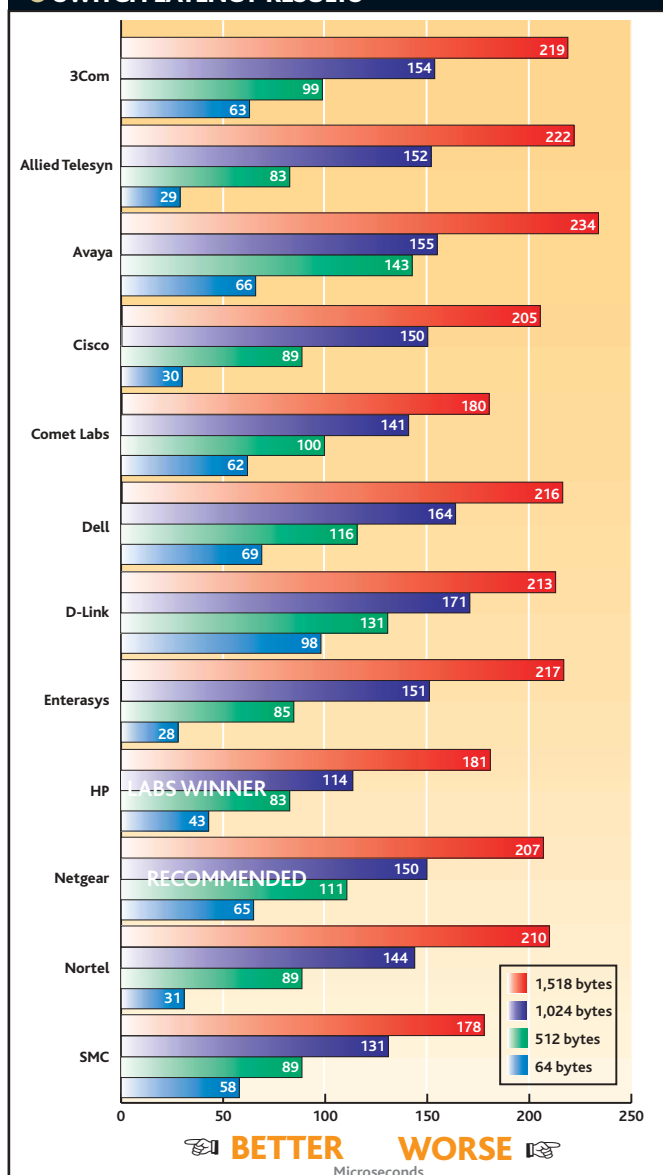
Performance is obviously an important factor, but when it comes to choosing the best from the rest, we take into account many other factors. The majority of switches on review offer an impressive range of features, but we also consider installation, as this task should incur minimum network downtime. Furthermore, the huge variety of traffic on today's LANs needs to be strictly controlled to ensure bandwidth isn't wasted, and to this end strong management facilities are just as important.

CONTACT: SPIRENT COMMUNICATIONS 01293 767970

● BACKBONE FRAME LOSS RESULTS

	1,518 bytes	64 bytes
3Com	80	79
Allied Telesyn	80	83
Avaya	83	76
Cisco	83	83
Comet Labs	74	67
Dell	80	83
D-Link	79	83
Enterasys	83	83
HP	83	83	LABS WINNER
Netgear	83	83	RECOMMENDED
Nortel	83	83
SMC	83	83

☞ WORSE   BETTER ☞
Frames received %

● SWITCH LATENCY RESULTS

	1,518 bytes	1,024 bytes	512 bytes	64 bytes
3Com	219	154	99	63
Allied Telesyn	222	152	83	29
Avaya	234	155	143	66
Cisco	205	150	89	30
Comet Labs	180	141	100	62
Dell	216	164	116	69
D-Link	213	171	131	98
Enterasys	217	151	85	28
HP	181	114	83	43	LABS WINNER
Netgear	207	150	111	65	RECOMMENDED
Nortel	210	144	89	31
SMC	178	131	89	58

☞ BETTER   WORSE ☞
Microseconds

3Com SuperStack 3 Switch 4226T

PRICE £663 (£779 inc VAT)   **SUPPLIER** 3Com 01442 438000

INTERNET www.3com.co.uk   **WARRANTY** Limited lifetime RTB

VERDICT This basic Layer 2 switch offers good performance at a fair price along with easy installation and management.

In our last switch group test (*see issue 84, p203*), 3Com's Switch 4400 walked away with a well-deserved Recommended award thanks to a fine combination of traffic management features, performance and value. The new 4226T is a simple Layer 2 switch that offers a more basic set of network services and comes equipped with a fixed configuration of 24 dual-speed ports and a pair of 10/100/1000BaseT ports.

In terms of build quality, you'll either love or hate 3Com's plastic chassis. We've always found it sturdy enough, but it will no doubt be easier to damage than the steel-shod alternatives. Underneath this baby-blue exterior lies a reasonable hardware specification that's similar to Cisco's 2950T-24, although 3Com can't match the Catalyst for features.

Up to 60 port and 802.1q VLANs can be created, but only two queues per port may be used for traffic prioritisation. Link redundancy is available with support for aggregated links and the switch can be stacked up to a height of four 4200 series switches. The stacking method is basic, as it requires one of the Gigabit ports on each switch to be used for the link and the latest firmware must be applied using 3Com's bundled TFTP server utility.

For performance, the 4226T failed to deliver a clean sheet, with a slightly higher than expected frame loss in the backbone test, although latency was on a par with the frontrunners. We contacted 3Com to discuss the results and it said the head-of-line blocking employed by the switch could have had a minor impact on performance.

The 4226T is aimed at offices without dedicated support staff, so it's designed to be easy to install and manage. All that's required is a quick trip to the CLI (command line interface) to assign an IP address to the switch and then it can be remotely managed using a browser that presents the same commands but in a more intuitive manner.

For general management, 3Com's standard interface is provided, with a switch graphic containing hotspots for quick access to port, expansion slot and switch settings, while Wizards offer assistance for setting up features such as broadcast control and port security.

PC PRO RATINGS

PERFORMANCE	★★★★☆☆
FEATURES	★★★☆☆☆
VALUE FOR MONEY	★★★★☆☆
OVERALL	★★★★☆☆

Allied Telesyn AT-8350GB

PRICE £1,213 (£1,425 inc VAT)   **SUPPLIER** Allied Telesyn 0118 920 9800

INTERNET www.alliedtelesyn.com   **BASIC WARRANTY** Three years NBD swap-out

VERDICT Good performance and expansion potential, but if you don't need the second module slot or stacking capabilities SMC or D-Link both look better value.

A glance at the low-profile front panel of the AT-8350GB shows this Layer 2 switch offers a similar port configuration to D-Link, HP and SMC. However, the 1000BaseT ports are partnered with the older GBIC slots, and a peek at the rear reveals an extra slot for more expansion modules, offering an additional two copper Gigabit or 100BaseFX fibre ports. This slimline chassis can also be placed in a physical stack of up to three identical units for a total of 144 ports, plus it features support for an optional redundant power supply.

With so much crammed into the front panel, there's little room for status indicators, although each port does have an accompanying LED. A mode switch lets you flick through link status, speed and duplex mode. Switching hardware is impressive too, as the AT-8350GB is endowed with a fast 32Gb/sec backplane that delivered good results in the backbone tests, with the SmartBits only reporting the expected frame loss in this test. Results from the latency tests were also encouraging, with switching speeds on a par with the competition.

A serial port is provided for CLI management, but we found it easier to dish out an IP address to the switch and use the remote browser facilities. Good supporting documentation is included too, although the interface is a simple affair. A graphic of the switch provides easy access to individual port settings, and a menu panel above neatly separates the various functions into basic and advanced operations. The basic option takes you to the physical layer for port configuration, mirroring and creating trunk groups, while selecting the Advanced tab allows you to configure VLANs and set up broadcast storm controls and port data mirroring. Simple QoS can be implemented by using the two priority queues.

The port security feature shouldn't be confused with the 802.1x access control variety, as the AT-8350GB only offers three basic port modes, which can limit the number of MAC addresses a port may learn or stop it learning any new ones.

A monitoring facility also allows you to view basic traffic statistics for individual ports, but the details are only delivered in tabular format.

PC PRO RATINGS

PERFORMANCE	★★★★★☆
FEATURES	★★★★☆☆
VALUE FOR MONEY	★★★☆☆☆
OVERALL	★★★★☆☆

Avaya P133GT2

PRICE £1,235 (£1,451 inc VAT)   **SUPPLIER** Avaya 0800 698 3619
INTERNET www.avaya.com   **WARRANTY** Limited lifetime RTB
VERDICT Easy installation and a smart management interface, but performance isn't perfect and features are basic for the price.

Formerly the Enterprise Networks Group of Lucent Technologies, Avaya was spun off as an independent company in October 2000. The P133GT2 is one of a modest range of workgroup switches offered by Avaya and complements its 24 dual-speed ports with a pair of fixed 100/1000BaseT copper Gigabit ports.

The main bank of two-dozen ports is set back in a panel to the right, while a display matrix above provides a wealth of visual information. A couple of buttons below let you switch between displaying link status, detected collisions, receive or transmit activity, link speed and duplex mode.

The P133GT2's comparatively low backplane capacity of 8.8Gb/sec should have coped with the performance tests, but the SmartBits revealed a slightly higher than expected frame loss at the full traffic load in the backbone test. Latency was also below par, with the SmartBits reporting slower than average times for frames to traverse the switch's backplane.

Swift installation is a key feature of the P133GT2 and Avaya makes every effort to ensure this is achievable. A visit to the CLI comes first and only requires a single command to provide the default VLAN with an IP address.

Avaya's VisAbility Management Suite provides the browser interface. It's well designed and easy to navigate, with a tidy graphic of the switch front panel providing hotspots for quick access to system and port settings. The various features can be reached easily from a menu bar above and a Wizard is provided for creating port trunks or LAGs (link aggregation groups). These allow high-speed, fault-tolerant links to be created between switches, and up to four LAGs, each consisting of eight ports, can be implemented.

The P133GT2 isn't stackable, but the Gigabit ports are promoted as a means of cascading more switches, and up to four can be placed in a stack and managed using a single IP address. The QoS feature set is only basic, as the P133GT2 offers four queues per port, 802.1p or port prioritisation and simple WRR (weighted round robin) queue servicing. However, up to 62 802.1q VLANs are supported and port-based VLANs can be created using drag-and-drop in the browser interface.

PC PRO RATINGS	
PERFORMANCE	★★★☆☆☆
FEATURES	★★★☆☆☆
VALUE FOR MONEY	★★★☆☆☆
OVERALL	★★★☆☆☆

Cisco Systems Catalyst 2950T-24

PRICE £795 (£934 inc VAT)   **SUPPLIER** Cisco Systems 020 8824 1000
INTERNET www.cisco.com   **WARRANTY** Limited lifetime RTB
VERDICT A huge feature set always puts Cisco's products high on an administrator's wish list, but small businesses may find many of the more proprietary options have limited value.

Despite being a fixed-configuration, standalone edge device, Cisco's diminutive Catalyst 2950T-24 comes armed with a comprehensive range of network features. The price may only include 24 dual-speed ports and a pair of triple-speed copper uplinks, but this member of Cisco's EI (enhanced image) family of switches also delivers support for the latest 802.1x port access control and 802.1w RSTP.

These features may not cut much ice with smaller businesses, but here the 2950T-24 can provide basic network backbone services by aggregating Ethernet and Fast Ethernet services and adding a couple of high-speed connections to Gigabit-enabled servers. Despite the modest 8.8Gb/sec backplane capacity, the performance tests showed it's up to the job, with a clean sheet on the backbone test combined with low latency.

Stacking options are impressive – Cisco's Cluster Management Suite (CMS) software allows up to 16 Catalyst 2950, 3550, 2990 and 1990 switches to be placed in one virtual stack and managed simultaneously from the same web interface, irrespective of their location. The 2950T-24 also uses Cisco's Per VLAN Spanning Tree technology that enhances the standard STP, allowing redundant uplinks to be created while also distributing traffic loads across multiple links.

There's much more to the 2950T-24, though, as it supports MAC-based port security, port aggregation using Fast EtherChannel and Gigabit EtherChannel, plus a wide range of QoS options, with four queues per egress port available for prioritising different types of traffic.

Installation starts at the notoriously complex CLI, although a new quick setup command runs swiftly through assigning an IP address and setting up an administrative password. Further management using Cisco's IOS will depend on experience – if the switch is slotting into a Cisco-centric network, there aren't any problems, but new users will find first contact with the CLI offputting due to the huge range of commands.

The Java-based CMS offers a friendlier face and has seen substantial improvements over the past year. It features easy access to switch parameters and cluster management along with slick Wizards for setting up various security scenarios and prioritising traffic from Cisco AVVID devices. The Visual Switch Manager (VSM) application is part of CMS and looks after traffic statistics by providing system or individual port data in tabular or graphical format.

PC PRO RATINGS	
PERFORMANCE	★★★★★☆
FEATURES	★★★★☆☆
VALUE FOR MONEY	★★★★☆☆
OVERALL	★★★★☆☆

Comet Labs GSR224T

PRICE £299 (£351 inc VAT) **SUPPLIER** Comet Labs 020 8332 1277

INTERNET www.cometlabs.com **WARRANTY** Five years RTB

VERDICT Moderate performance under pressure, but there's no web management and basic features. However, at this low price you can't expect any more.

Companies such as Netgear and D-Link may be cleaning up in the entry-level switching market, but they should keep an eye on US-based Comet Labs.

Despite the fact it was only formed in 1997, Comet Labs already offers an extensive range of budget-priced network products. The latest GSR224T aims to deliver Ethernet switching on a shoestring. For a ridiculously low £299, you get a full complement of 24 10/100BaseTX ports and a pair of copper Gigabit uplinks that can be used for high-speed server links or cascading other Gigabit switches from.

The dual-speed ports are accompanied by an informative LED matrix that advises on link status, speed, duplex mode and detected collisions, while the Gigabit ports get their own indicators showing negotiated speed and activity.

By now, you'll be asking what's the catch – and the answer is in the minimal management tools and features. The Comet Labs GSR224T manages to rise above the status of a dumb, Layer 2 switch thanks to the serial port at the rear.

Over a local cable connection, you can access the CLI, which provides a simple menu with basic options. The first allows you to view port status, although this only shows whether the port is set to auto-negotiation or at a fixed speed and not its actual link status.

VLANs are on the menu too, but the review unit didn't have the necessary firmware upgrade so it only allowed us to create up to six port-based VLANs.

Comet Labs was advised of this, but was unable to supply the required upgrade for the review. Consequently, 802.1q VLANs, 802.1p packet prioritisation and port mirroring were unavailable.

Apart from resetting to factory defaults or warm-starting the switch, the only other menu option is for port trunking, as the GSR224T supports up to seven groups, each with a maximum of four ports. A backplane capacity of 9.6Gb/sec looks capable of handling the demands of the target market but, although latency was impressively low, the SmartBits reported a comparatively high frame loss of 33 per cent during the backbone test.

Overall, the GSR224T looks a good choice for basic switching duties on small networks, but if you want web access look elsewhere.

PC PRO RATINGS

PERFORMANCE	★★☆☆☆☆
FEATURES	★☆☆☆☆☆
VALUE FOR MONEY	★★★★★☆
OVERALL	★★★☆☆☆

Dell PowerConnect 3024

PRICE £464 (£545 inc VAT) **SUPPLIER** Dell 0870 152 4699

INTERNET www.dell.co.uk **WARRANTY** One year NBD swap-out

VERDICT Dell takes the initiative in the value stakes, so this switch will appeal to small businesses on a tight budget.

Dell's sales successes in the networking sector during 2002 ruffled more than a few feathers. Its status as a reseller of Cisco and 3Com equipment ended dramatically, with the former naming it as a direct competitor. This didn't stop the PC vendor for long, though, as it now offers its own range of Ethernet switches and has big plans to expand into the higher end Gigabit Ethernet sector during 2003.

The PowerConnect range currently comprises a modest selection of dual-speed and Gigabit Layer 2 switching products. We were advised that these are designed and built to Dell's specifications, but the PowerConnect 3024 on review bears more than a passing resemblance to the Netgear FSM726S. The only external differences are the location of the 1000BaseT and GBIC port pairs, plus the lack of a mode switch next to the port status display.

Few differences are evident under the bonnet too, although Netgear does use a faster IDT 64-bit RISC processor. It's also worth noting that Dell's PowerConnect 3248 is identical to SMC's TigerSwitch 6750L2 and HP's ProCurve switch 2650, so Dell is sourcing its network equipment from the same manufacturer.

Switching hardware is reasonable for the price. The 3024 offers a 12.8Gb/sec backplane, which held up well in the performance analysis, with the SmartBits reporting only a marginally higher than expected frame loss in the backbone test. Latency proved to be less impressive, with both Dell and Netgear returning similarly sluggish switching speeds at the full 100 per cent traffic load.

Installation and configuration are helped by the good documentation, an intuitive CLI and well-designed browser interface. This offers easy access to switch and port settings and provides useful graphical performance details on each port.

We found VLANs particularly easy to set up. Each requires just a few mouse clicks to add ports and opt for packet tagging to determine which traffic is placed in low- and high-priority queues.

Being one of the largest server and workstation vendors gives Dell an advantage, as the PowerConnect range allows it to deliver an end-to-end networking package. If this doesn't impress, the bottom line comes down to extra cash or more warranty and, of course, colour.

PC PRO RATINGS

PERFORMANCE	★★★★☆☆
FEATURES	★★★☆☆☆
VALUE FOR MONEY	★★★★★☆
OVERALL	★★★★☆☆

ENTERPRISE
Ethernet switches

D-Link DES-3250TG

PRICE £880 (£1,034 inc VAT)   **SUPPLIER** D-Link 020 8731 5555

INTERNET www.dlink.co.uk   **WARRANTY** Limited lifetime NBD swap-out

VERDICT Reasonable performance and a high port density at a tempting price, although support for the latest standards is yet to be implemented.

D-Link has always been associated with low-cost networking products for small to medium-sized businesses and the DES-3250TG continues this tradition.

This standalone, managed Layer 2 switch delivers 48 dual-speed ports and a pair of 1000BaseT ports all at a modest price. A couple of small form-factor mini-GBIC slots are also provided for longer distance connections over 1000BaseSX or LX fibre links, but using these will disable the corresponding copper Gigabit port.

The dull brown chassis and fascia make the DES-3250TG the least interesting switch to look at on test, but underneath its bland exterior lies a reasonable hardware specification. However, the SmartBits did report a slightly higher than expected frame loss for 1,518-byte frames during the backbone test, although latency at the full traffic loads was well within acceptable parameters.

The build quality of D-Link products has always been good, and the pair of small cooling fans to one side barely produces a whisper, making this one of the quietest switches on review. Visual information is limited, though, with just a single LED showing either link status or activity on each port.

The documentation offers in-depth coverage of all the switch features and how best to use them, making this an easy product to install. The browser interface provides easy access to all configuration settings, and a graphic of the switch has hotspots for one-click access to port settings.

Port trunks for resilient links can be created too and, although it's unlikely they will all be used, the switch can handle up to 255 802.1q VLANs. Also, low- and high-priority queues for each port allow 802.1p packet prioritisation to be implemented.

When it comes to support for the latest Ethernet standards, look behind the marketing hype before buying, as although the DES-3250TG claims to offer 802.1x port access control, 802.1w RSTP and 802.1ad link aggregation, at the time of writing these were only due to be implemented in future firmware upgrades.

Traffic monitoring tools offered by the browser interface are better than most. Overall switch statistics such as frames per second and port utilisation can be viewed as a simple numerical chart or you can look at individual port utilisation as a line graph, mull over a packet analysis or check on errors.

PC PRO RATINGS

PERFORMANCE	★★★★☆☆
FEATURES	★★★☆☆☆
VALUE FOR MONEY	★★★★☆☆
OVERALL	★★★★☆☆

Enterasys Matrix E1 1H582-51

PRICE £4,450 (£5,229 inc VAT)   **SUPPLIER** Enterasys Networks 01635 580000

INTERNET www.enterasys.com   **WARRANTY** One year RTB

VERDICT Good traffic management tools plus strong security measures, but at this price we expect better remote management features.

The E1 sits alone in the Matrix family of switches, as its bigger brothers are all chassis-based systems aimed at core switching duties. Even so, this 2U chassis looks to provide plenty of top features, including Layer 2, 3 and 4 switching and routing, as well as a high port density and good expansion options. Along with 48 fixed dual-speed ports, you can add up to three modules for Gigabit uplinks over copper and fibre connections. Enterasys also offers 16-port 10/100BaseTX port modules, so you could double the port count if required.

The Matrix is unusual, as it comes with a pair of internal power supplies offering fault tolerance straight out of the box. However, it truly is a standalone switch, with no physical or virtual stacking options in evidence. That said, you can create up to six fat trunks with other Matrix switches, each comprising up to eight ports and supporting load balancing and redundancy.

Plenty of traffic control tools are available. It's possible to implement QoS using eight traffic classifiers, four queues per port and three methods of queue servicing. Security is also high on the agenda, as the Matrix supports 802.1x port access authentication via a Radius server, and administrative access can be tightly controlled with MAC port locking and MAC address authentication.

Installation starts at the CLI, for which the Matrix uses an RJ-45 port and a serial port converter, allowing the switch to be accessed by a PC over standard UTP network cabling. The CLI isn't the easiest to comprehend, but the manual makes a valiant effort at unravelling its mysteries. The plain web interface won't win any design awards either – it doesn't even provide a switch graphic with hotspots. However, it does lay out all the main functions in tidy groups for easy access.

Unlike HP's ProCurve switch 2650, performance monitoring is limited – all the web interface offers is a simple numerical table for each port showing received bytes and frames along with detected errors. Unfortunately, many features of the Matrix will require a trip to the CLI, as areas such as Layer 3 routing and port access authentication aren't accessible from a web browser, forcing remote administrators to Telnet in to configure or view their settings.

PC PRO RATINGS

PERFORMANCE	★★★★★☆
FEATURES	★★★☆☆☆
VALUE FOR MONEY	★★★☆☆☆
OVERALL	★★★★☆☆

HP ProCurve switch 2650

PRICE £1,175 (£1,381 inc VAT) **SUPPLIER** Hewlett-Packard 0870 240 2479
INTERNET www.hp.co.uk **WARRANTY** Limited lifetime NBD swap-out
VERDICT A better choice than SMC or D-Link. The 2650 delivers top performance, plenty of features and the best web management tools around.

HP confirms that teaming up 48 dual-speed ports with copper and SFP (small form-factor pluggable) GBICs (gigabit interface converters) is the latest trend, as the sleek ProCurve 2650 is virtually identical to SMC and D-Link's many-ported offerings.

As with the TigerSwitch 6750L2, the dual-speed ports are laid out neatly across the front panel, with a single multifunction status indicator provided for each one. To the right is a pair of fixed triple-speed copper Gigabit ports and a corresponding SFP GBIC. HP delivers the best fibre options on test, as it offers 1000BaseSX, LX and long-haul LH modules. Stacking options are also vastly superior – up to 16 ProCurve switches can be placed in a virtual stack and managed using a single IP address without the need for expensive stacking modules and extra cabling.

Installation is a cinch – you assign an IP address using a single CLI setup command and then abandon this for the sophisticated remote web browser console. Despite being introduced a number of years ago, this is still one of the best interfaces around, providing easy access to switch and port settings and offering plenty of performance details from a large bar graph showing traffic throughput on all ports.

An alert log is also displayed underneath, and any problems are accompanied by links to screens offering advice on likely causes and possible actions to remedy them. The only drawback is that the bar graph can only display all 50 ports if your monitor resolution is upped to at least 1,280 x 1,024.

The bundled copy of HP's TopTools for Hubs and Switches delivers even more detail, as it brings into play full traffic monitoring and analysis. Network performance and throughput data can be saved to disk for use in reports, and TopTools is able to analyse traffic trends, identify potential bottlenecks and offer recommendations for improvements to the network.

Along with top management tools, the 2650 scores highly on performance, delivering a clean sheet in the backbone test as well as low latency. Features are also more plentiful than the competition, as along with the standard QoS tools, support for the latest 802.1x access control and 802.1w RSTP is already implemented in firmware.

PC PRO RATINGS

PERFORMANCE	★★★★★★
FEATURES	★★★★★★
VALUE FOR MONEY	★★★★★★
OVERALL	★★★★★★

Netgear FSM726S

PRICE £582 (£684 inc VAT) **SUPPLIER** Netgear 01344 397021
INTERNET www.netgear.co.uk **BASIC WARRANTY** Five years NBD swap-out
VERDICT Virtually identical to Dell's PowerConnect 3024 and just as simple to install and manage. Slightly more costly, but still excellent value thanks to its superior warranty.

If imitation is the sincerest form of flattery, Netgear's FSM726S has a lot going for it – Dell's new PowerConnect 3024 is virtually identical. Netgear is a force to be reckoned with in the small to medium-sized business networking sector, as it has concentrated solely on this area ever since it was spun off from Nortel Networks in 2000 and has now captured a sizeable chunk of the UK market.

The FSM726S was announced as Netgear's first managed switch in the beginning of 2002 and made its initial appearance in the UK a few months later. It's a compact box offering 24 10/100BaseTX ports and a good combination of Gigabit Ethernet options for the price.

Of most interest is the pair of 1000BaseT ports, as these can be used for low-cost backbone or high-speed server connections over copper, but each port is also paired with a GBIC (gigabit interface converter) slot. These accept industry-standard 1000BaseSX and LX GBIC modules, allowing long-distance fibre-optic connections to be implemented, although the high cost of the cabling limits their value to smaller businesses. The copper and GBIC ports are arranged in pairs, so you can only use one of each and the interfaces must be selected from the management interface.

For switch management, you get the same CLI and browser interfaces as for the Dell, but with a spot of Netgear branding plastered over them. Consequently, you'll find them easy to use, with good access provided to switch parameters and statistics.

Up to six switches can be physically stacked together using the supplied cables. To test this, we joined the Dell and Netgear switches together via their rear ports, where they appeared in the browser window as one unit with a single IP address. The comprehensive display panel on the switch keeps you in touch with port-related action, and the FSM726S provides stack status indicators as well.

Companies that find this switch appealing have a difficult choice ahead, as both Netgear and Dell offer tempting propositions. Neither will disappoint and, while the substantially lower cost of the PowerConnect 3024 will sway many, the decent five-year guarantee offered by Netgear makes the FSM726S a more attractive long-term bet.

PC PRO RATINGS

PERFORMANCE	★★★★★★
FEATURES	★★★★★
VALUE FOR MONEY	★★★★★★
OVERALL	★★★★★★

Nortel Networks Business Policy Switch 2000

PRICE £2,769 (£3,254 inc VAT)
INTERNET www.nortelnetworks.com
SUPPLIER Nortel Networks 01628 432000
WARRANTY Limited lifetime RTB
VERDICT The BPS 2000 delivers unbeatable traffic management and QoS features, making it well suited to larger networks running bandwidth-intensive applications.

Surprisingly, this is Nortel Networks' first appearance in *Enterprise* and it makes its debut with the Business Policy Switch (BPS) 2000. We chose this switch as it's one of the few in Nortel's huge range to offer a pair of copper Gigabit uplink ports. Plenty of its switches have GBIC (gigabit interface converter) slots, but at the time of writing Nortel advised us that it didn't supply copper 1000BaseT GBICs, as those available on the market didn't meet all required specifications.

The BPS 2000 satisfies our minimum port requirements with 24 dual-speed ports and a dual-port Gigabit expansion module. Its comprehensive display matrix provides plenty of information about port status, speed, duplex mode and activity. The price for this switch looks steep, but the BPS 2000 is aimed at intensive network applications such as VoIP (Voice over IP) and video streaming, and consequently provides an impressive array of traffic management and prioritisation tools along with good security measures.

A key feature is the use of policies to control network traffic. These are assigned to specific interface groups that contain some or all of the switch's ports and define the types of actions to be taken when traffic matching a particular pattern is received. The BPS 2000 uses DiffServ (differentiated services) and QoS for traffic prioritisation along with eight hardware queues, so it offers an exceptional range of options. The dual-port Gigabit module also has built-in intelligence and can perform its own shaping duties, allowing traffic to the network core to be utilised more efficiently.

With all these tools, switch management needs to be good and we were pleased to find an intuitive browser interface. The myriad of features is arranged in a tidy Explorer-style menu and plenty of online help is provided, along with abundant Wizards. Lots of Ethernet statistics are available too, but these are presented in a dull tabular format.

The Java-based Device Manager provides more in-depth information in a similar format, while the Optivity Switch Manager uses the Device Manager to look for devices compliant with Nortel's autodiscovery protocol and creates maps for easier administration.

PC PRO RATINGS

PERFORMANCE	★★★★★☆
FEATURES	★★★★★☆
VALUE FOR MONEY	★★☆☆☆☆
OVERALL	★★★★☆☆

SMC TigerSwitch SMC6750L2

PRICE £899 (£1,056 inc VAT)
INTERNET www.smc.com
SUPPLIER SMC Networks 01932 866553
WARRANTY Five years RTB
VERDICT A well-built switch with plenty of ports for the price and good performance. Superior management tools make it a better bet than the similarly priced D-Link.

SMC's latest high-density Layer 2 switch shows just how low prices have dropped, making deployment of switched Fast Ethernet to the desktop a reality for many smaller companies. Similarly priced to D-Link's 48-port switch, it also delivers the same helping of Gigabit Ethernet uplink choices and an equally useful level of features.

The TigerSwitch is sturdily built and, although each port only has a single LED, a mode switch allows their function to be swapped between showing link status, activity or duplex mode. Unlike D-Link, SMC also offers an optional redundant power supply (£499) that provides fault-tolerant links for up to four switches.

The 6750L2 is truly a standalone switch, as it offers no physical or virtual stack options. However, trunk groups comprising up to four ports apiece can be used to create fat pipelines with other switches, and support for the LACP (link aggregation control protocol) means the TigerSwitch is able to automatically negotiate trunked links with other LACP ports. It offers a basic range of QoS tools so traffic management can be implemented, and four priority queues allow untagged traffic entering the switch to be sorted in queues at the relevant destination ports. However, it's also another switch that needs an as yet unreleased firmware upgrade to support new features such as 802.1x port access control and 802.1w rapid spanning tree.

As is the case with most Layer 2 switches, the TigerSwitch can be plugged directly into the network without any further configuration. Management requires a mercifully brief trip to the CLI to assign an IP address and then you may escape to the friendlier browser interface. This provides good access to switch parameters, with a simple menu system for each category.

Traffic data is minimal, though, with the Statistics window merely showing a few basic tables on Ethernet data and RMON history.

SMC's quirky EliteView is more fun, as it can display detailed views of switch alarms, history and statistics. Once you've selected a port to monitor, it allows you to to take an in-depth look at areas such as utilisation, errors, traffic flow and packet throughput in both graphical and tabular format. EliteView certainly isn't as sophisticated as HP's TopTools, but it's still capable of providing plenty of useful information about the switch.

PC PRO RATINGS

PERFORMANCE	★★★★★☆
FEATURES	★★★★☆☆
VALUE FOR MONEY	★★★★☆☆
OVERALL	★★★★☆☆