ProCurve Networking by HP 7102dl Secure Router Test

A Broadband-Testing Report

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EXECUTIVE SUMMARY

Within this report we put the ProCurve 7102dl secure router to the test over a period of several weeks of intensive use.

Our test environment consisted of both internal – simulated – and external (Internet) networks. For the internal tests we used a pair of Spirent Avalanche/Reflector client and server traffic generators, simulating up to 100 (the recommended maximum supported number of users) clients across a series of tests. For external testing we connected to a Wanadoo ADSL service for Internet access, running at 7.6Mbps downlink speed and 960Kbps uplink speed, simulating a classic branch office or small-medium business (SMB) scenario.

We focused on two areas, the first being the ease of configuration, deployment and day-to-day management of the 7102dl, given its intended location – branch office or SMB - where local technical staff are unlikely to be available. Our second focus area was on the breadth and depth of features available on the 7102dl – does it provide enough options to satisfy a broad range of potential user types, given the target market for this product?

Additionally, we wanted to evaluate to suitability of the 7102dl for deployment in the kind of packaged managed solution offered by service providers and TelCo's now often favoured by the SMBs. In this scenario, support costs must be kept as low as possible, so ease of use and reliability are everything.

The fundamental problem that a vendor has when trying to marry the simplicity associated with basic devices, to the richness of functionality associated with an "enterprise class" product is that the result is either overly complex to use or too simplistic in terms of feature set. However, with the ProCurve 7102dl, HP has used a great deal of common sense, providing what would be regarded as the key elements – comprehensive and flexible security options including a simple to configure firewall and VPN (with accelerator module), a graphical management interface that lets you carry out almost all day-to-day tasks without resorting to the CLI (Command Line Interface) and a broad enough – without being excessive - choice of initial configuration options in the first place, courtesy of the range of WAN modules available.

Thereafter, features such as Quality of Service (QoS) and Access Control Lists (ACL) have been fully implemented, should they be required, but these are not intrusive – they are they if you need them. Perhaps more important – given the target audience – is the comfort that "features" such as the unlimited product warranty that comes with the 7102dl brings. This means that the price you pay to buy the product is the only cost you'll incur, short of changing the WAN module for a different "flavour" at some stage, should you so choose to do.

Overall then, the ProCurve team seems to have got the balance between simplicity and feature-rich right on this WAN edge device, the 7102dl, which will fit the bill for any SMB, branch office, or managed service packaged aimed at the 25-100 user market.

INTRODUCTION – EASY TO USE, RICH IN FEATURES – REALITY OR IMPOSSIBILITY?

It's all too easy to make it sounds like a pipe-dream – combining extensive, enterprise-class features with an ease of use level that enables non-technical branch office workers, or small-medium businesses (SMBs) to fully take advantage of that feature set…

However, this is the challenge the ProCurve team has faced up to on the introduction of the 7000dl series of WAN edge device, or routers in old money, the 7102dl model being the focus of this report. The aim here is to not in any way short-change the target customer (branch office or SMB being the classic examples) when it comes to features, but to make them easily accessible and usable, without the need for a dedicated systems engineer onsite.

Let's be realistic and honest here; there are low-cost options available in the remote access, router cum firewall market, that will do a job at a very attractive price, should those requirements be simple and set in stone. In other words, entry-level products are exactly that – a first step along the way, with little or nothing in the way of scalability or flexibility. Where the 7102dl differentiates itself from these "first-step" products is by offering a very extensive range of functionality – for example, in the area of security – the choice of WAN connectivity options via its WAN modules, allowing for the router to grow with the company and the ability to support many different types and levels of user on the same device. HP would also be quick to add that there is an important price story here too; the company looks to undercut its most obvious rival by 50%.

So, in the all-important areas of quality, reliability and depth of features, the 7102dl has to be 100% in line with its siblings aimed at the enterprise level audience. In other words, continuing the enterprise theme, what they have back at the head office must be mirrored at the branch or remote office, whether that's security related, virtual networking related or simply to ensure permanent, high-quality connections. Let us, then, consider what kind of requirements are at the forefront, for an edge device aimed at the branch office or SMB markets.

- Secure, easily configured management with remote capabilities.
- Integrated, enterprise-class security functions including site-to-site VPN for secure head office to branch office connections, or multiple client VPN tunnels to remote sites.
- WAN gateway functionality with DHCP, NAT and other functions integrated to make life as easy as possible for anyone connecting to the network.
- The flexibility to offer different levels of user access and usability – for example, providing an easy but secure way of allowing visitors access to the Internet.
- Low and easily calculated TCO (Total Cost of Ownership) notably for SMBs and managed service scenarios.

We will now take each of these areas and examine them in more detail, in the form of a features and functionality test, starting with an overview of the product.

AN OVERVIEW OF THE PROCURVE 7000DL FAMILY

Secure Router 7203dl

The ProCurve 7102dl is part of the 7000dl secure router series. It has a bigger brother in the form of the 7203dl.

Figure 1 –ProCurve 7203dl Secure Router

Designed to support 100-1000 users, the 7203dl features three module slots (two wide, one narrow) supporting up to eight E1 lines by default, and up to 12 in total, plus two back-up lines. A redundant PSU is available. A Redundant Power Source (RPS) port can interface to a ProCurve RPS device so, in case of an internal power supply failure, the RPS will automatically failover without the router losing the link. In general it shares many features with the 7102dl, which we'll now look at in more detail.

Secure Router 7102dl

Figure 2 –ProCurve 7102dl Secure Router

Designed to support 10-100 users, the 7102dl features two narrow module slots and supports up to four E1 lines. As with the 7203dl it is a standard 19" rackmount format case, configured as standard with a console port, two Ethernet ports and a bank of status LEDs. On the back panel are two interfaces; one is for a Compact Flash (CF) card. This is a neat idea, meaning that multiple system and configuration files can be stored on the card, which can be shipped out separately from the device for "plug 'n' play configurations and updates, without the need to be connected to the Internet or private WAN.

A "SafeMode" enables the router to boot from a safe, default configuration. And in order to ensure synchronization between the system memory and CF, an "AutoSync" feature guarantees that system and configuration are backed-up in the compact flash. It also means you can easily rollback and forward between different configurations, in the event of needing to do so.

Next to the CF slot on the back panel is a slot for an optional IPSec VPN accelerator/encryption module.

Figure 3 –ProCurve 7102dl Secure Router – Rear Panel

The range of modules for the 7102dl is extensive, without being bewildering. Options include a 1xE1 plus Backup, 2xE1, Serial (V.35/X.21), E1+G.703+Backup and ADSL 2+ (Annex A or B) plus Backup. Our review sample came configured with the latter two module options.

The 7102dl ships with two management/configuration options – a classic (Cisco-alike) Command Line Interface (CLI) and a browser-based management interface that is built-into the router itself. More on these in the next section. Secure Shell (SSHv2) access is also available for secure management, as well as outgoing and incoming Telnet access. As we've already mentioned, configurations can be stored on the optional CF card, in running memory, or on the router.

An integrated DHCP server is provided and the 7102dl is SNMPv2 compliant. TFTP and FTP servers are also integrated. A built-in HTTP server provides the management GUI, though this can also be set to secure HTTPS access.

A broad range of security features includes stateful firewall, NAT, Access Control Lists (ACLs), VPN (site-to-site and multiple client tunnels) support for IPSec, support for a wide range of Key Exchange Protocols including Diffie-Hellman, RSA and IKE, 802.1x authentication support and RADIUS and LDAP support.

Though routing is enabled by default across all ports, the 7102dl also fully supports bridging mode – transparent bridging over PPP and Frame Relay and Spanning Tree over Ethernet and Frame Relay – 802.1d or 802.1w modes. Routing protocol support includes RIP v1/v2, OSPF and BGP4. Multicast support for IGMPv2 and Multicast stub routing is also included. From a redundancy perspective, as well as the backup port on each module, full multi-link PPP (MLPPP) and multi-link Frame Relay are supported.

A variety of QoS mechanisms are available that can be applied to different interfaces and different user types, from weighted fair queuing, through DiffServ, to Priority Queuing, bandwidth allocation by protocol type (for real-time traffic) and variable bandwidth levels of allocation.

HP 7102DL – FEATURE AND FUNCTIONALITY TEST

The Testbed

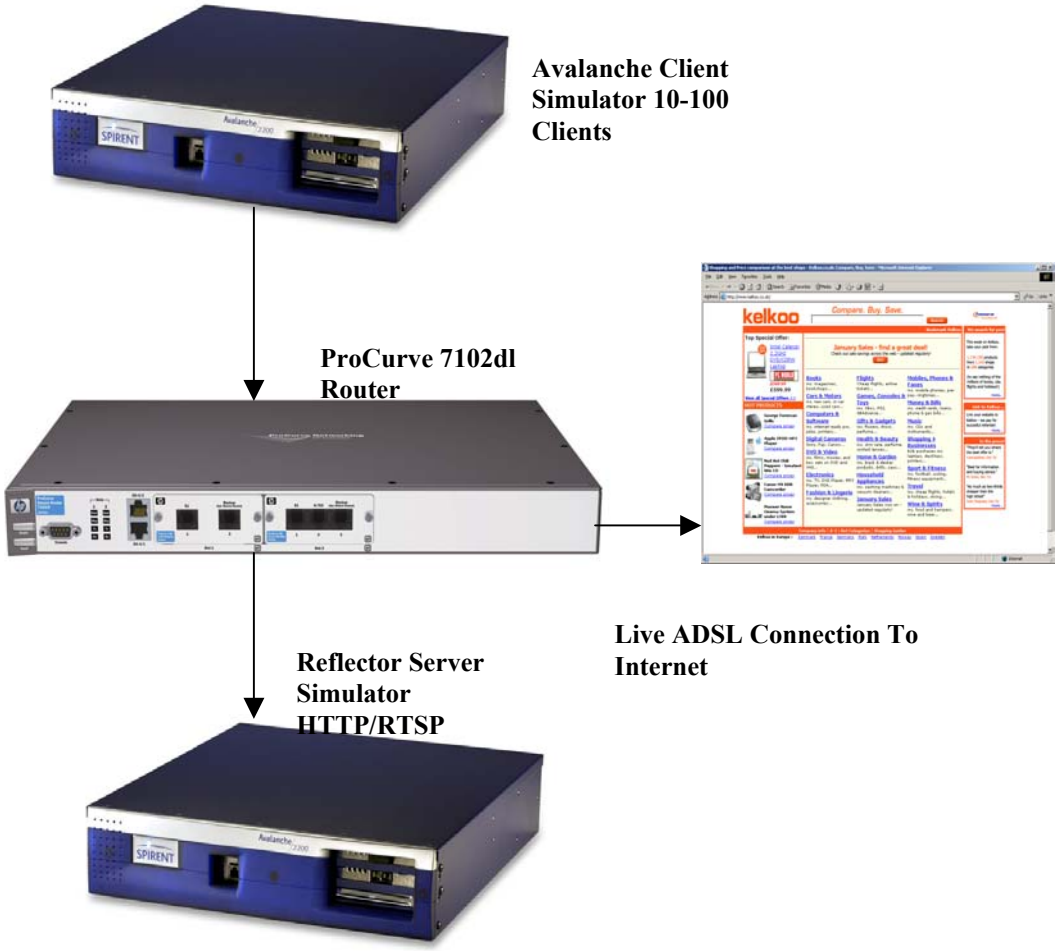

Figure 4 –The Broadband-Testing Testbed

In order to test the features, functionality, scalability and reliability of the ProCurve 7102dl, we created a testbed consisting of both live and simulated traffic and tests and ran the 7102dl for over a month, using it as our office router. We configured private and public networks, each on separate subnets using each of the integrated Ethernet ports, then configured the ADSL module to connect to our live ISP – Wanadoo. Our test bed consisted of Spirent's Avalanche (client) and Reflector (server) web traffic generators (see appendix) to create simulated web traffic.

We created virtual HTTP and RTSP (Quicktime video streaming) servers with the Reflector and 100 virtual clients on the Avalanche, tests starting with 10 users and adding 10 at each iteration, up to the 100 maximum. This simulated a typical target user configuration for the 7102dl, albeit with higher traffic patterns than we would expect to see in a typical office environment, but then this is a test!

Ease Of Configuration And Deployment – Put To The Test

Initial Configuration

The 7102dl arrived with a preset IP address and the DHCP server enabled, so that configuration could immediately be carried out via an Ethernet-connected PC and the browser-based management GUI, or via telnet or SSH sessions, or via the serial port to the CLI.

Figure 5 – Management GUI – Main Menu

We attached the ProCurve to an HP 2824 Ethernet switch, via the first of its two Ethernet ports (interface 0/1) and then connected a laptop to the same switch. The laptop picked up an IP address from the router so we then simply had to point a browser at the default IP address, to look at the managment GUI. On loading, you are presented with a system summary showing important information in the event of a technical support call being required; everything from the current firmware version, serial number and current boot image, to the status of the CF memory and even the fan status is available from a single screen. Excellent – lots of valuable information, easily accessed.

The management GUI – which can be accessed via plain http or a secure https session - is based around a menu on the left-hand side of the screen and the information panel on the right. Clicking on any topic on the menu changes the main screen content to that particular topic. In addition to the standard screens there are a number of wizard options – depending on the topic – that walk you through a configuration (see later). From the GUI it is

also possible to launch a telnet session which pops up automatically in the form of a “DOS box” in addition to the browser window, which stays open.

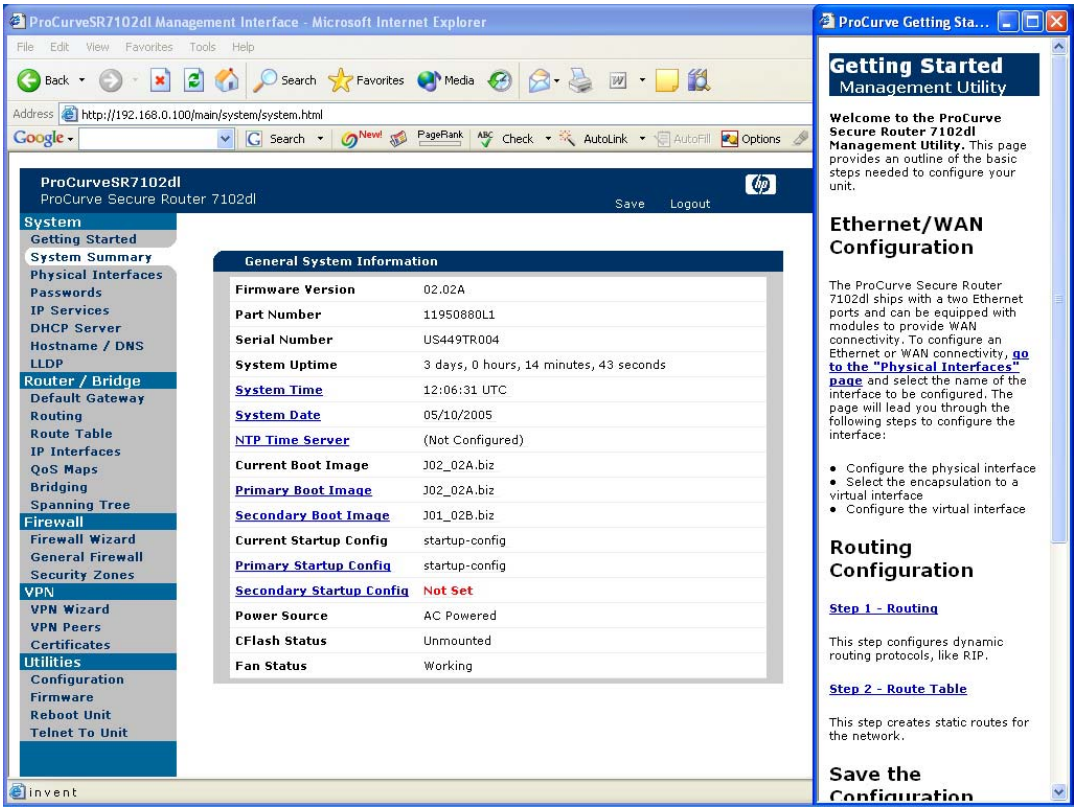

Figure 6 – Management GUI – Getting Started

The first option on the menu, under the System heading, is Getting Started. Clicking on this loads a help screen on the right-hand side. This walks you through some basic network configurations, via hyperlinks to the relevant management screen. There is also an Advanced Getting Started option that leads to a number of hyperlinked advanced configuration options. Context-sensitive help is also available in some cases, marked with a “?” by the topic. Hovering over the question mark brings up the relevant text. In addition to the online help, HP provides a range of documentation, both in paper format – a Quick Start guide and an Installation Guide – and in the form of .pdf files. Several configuration examples can be downloaded from the website, along with many other useful documents, so you don’t have to only rely on the internal help utility.

Configuring The Interfaces

Which interfaces you configure will depend on what module options the 7102dl was ordered with. In our case we wanted to set up both an internal network – simulating an Internet connection over the second Ethernet port, but this could just as easily be a company Intranet – and an external network; namely an Internet connection via the ADSL router module that came pre-installed.

Whatever the interface, the basics – whether using the GUI or the CLI – follow the same format. The actual details vary, depending on the interface type – for example Ethernet or ATM (ADSL) – but essentially you are presented with a screen and some basic options; advanced options are

usually available via clicking on a separate options box, so there is never too much information on one screen. The only time you need to scroll down to see information initially hidden at the bottom of the screen is normally when there is a statistics box – typically showing packets/bytes transferred and received, the interface/line status and similar information.

Routing is enabled by default on each interface, but can be disabled. The interfaces can individually be enabled/disabled via the GUI or CLI.

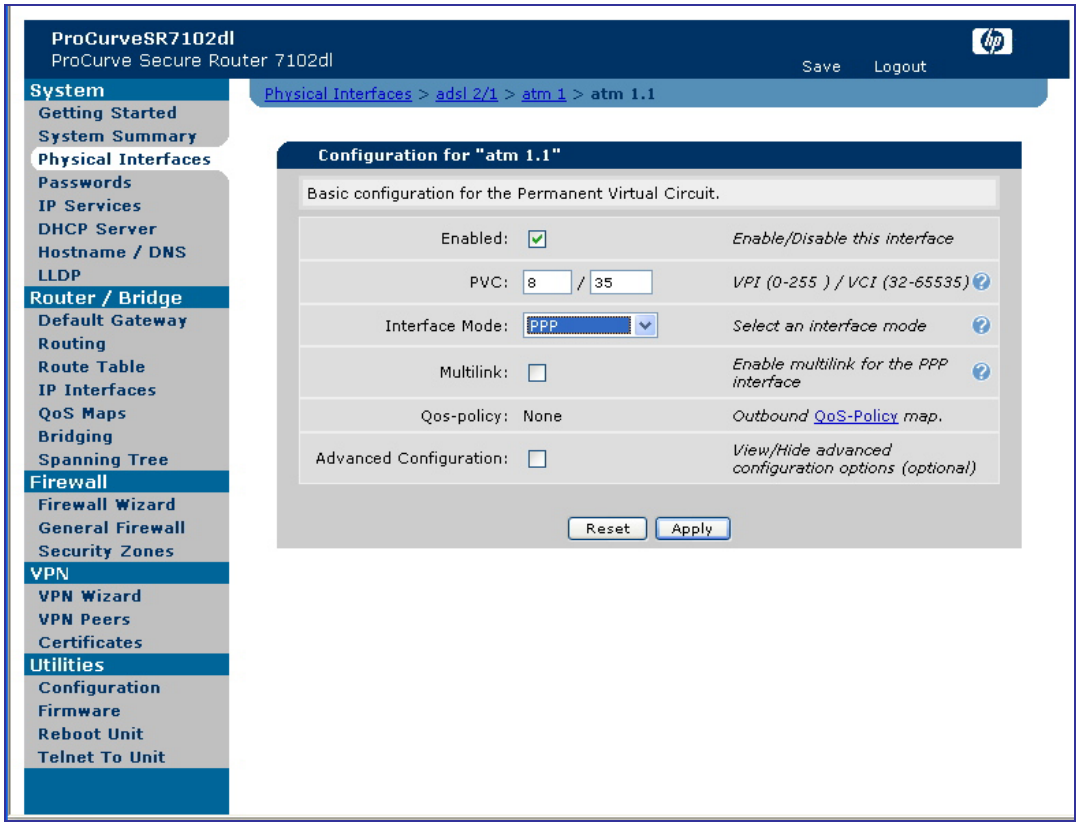

Figure 7 – Management GUI – Configuring The ATM (ADSL) Interface

Security Tests

Firewall

One of the first tasks any customer would want to undertake is to configure and enable the firewall. With the 7102dl, HP provides an integrated stateful firewall that is entirely configurable via either the CLI in traditional fashion, or at the GUI, with the option of using a firewall wizard to create the initial configuration.

With the wizard, where once firewalls were oppressive things to configure and certainly not for the non-technical who, likely as not, would accidentally lock themselves out of the system, now there is a graphical representation of exactly what you are configuring, as you configure it. The wizard is a multi-step procedure, asking which interface you want to secure and what kind of basic policy – for example, Allow – you wish to apply. We created a policy initially for the second Ethernet port (0/2) which was to be our simulated WAN/Internet access port.

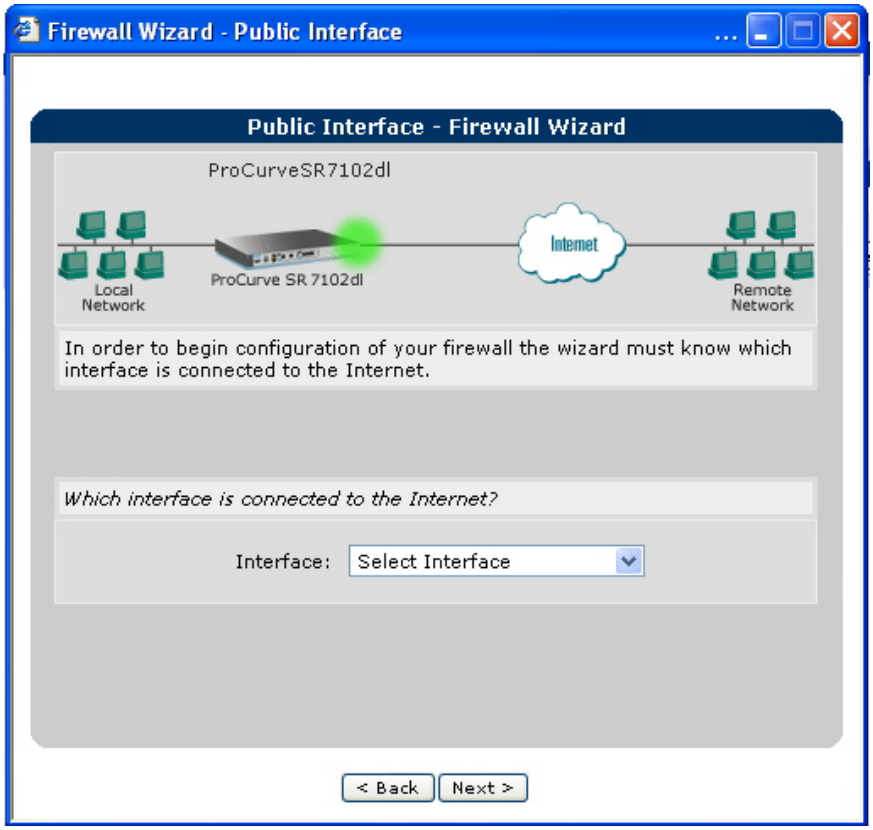

Figure 8 – Management GUI – Using The Firewall Wizard

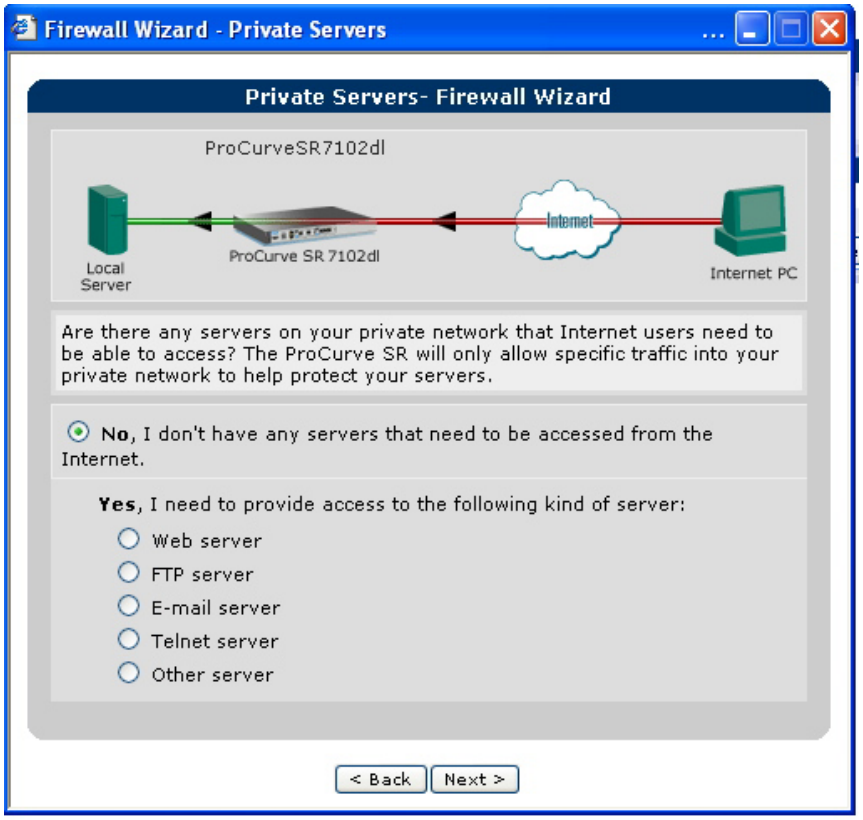

Figure 9 – Management GUI – Using The Firewall Wizard – Selecting Server Access

Wizard options also include selecting which – if any – type of internal (private network) server you need to allow access to from the Internet, such as a web server, or an FTP server.

It literally takes about 60 seconds to create a basic firewall configuration that, in reality, would probably satisfy about 50% of the users of this product. Thereafter, at both the GUI and CLI, it is possible to add and change firewall configurations, given that you are likely to need different policies for different interfaces.

This customisation revolves around the idea of creating security zones – each zone has its own set of firewall rules – which can then be applied to any of the interfaces. For example, we created a NAT-based rule to police and allow specific traffic across the external (Internet) connection, on an incoming basis, while allowing any outgoing traffic.

We also combined firewall and QoS (see later) mappings in order to both optimise traffic and deny it in different configurations and different test scenarios, using the UDP protocol and video streaming (RTSP). At the CLI we were able to see the firewall working – here denying RTSP return traffic from public to private interface (see below).

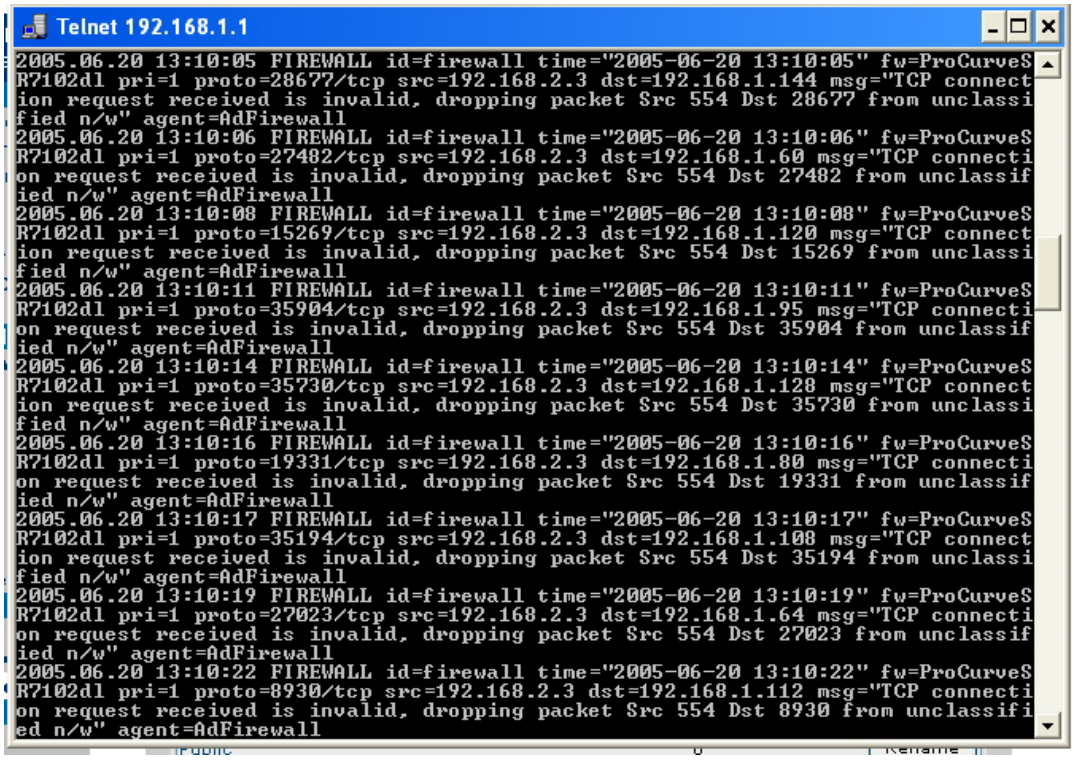

Figure 10 – At The CLI – Checking Firewall Policies

Overall, the firewall offers an excellent compromise between ease of use and depth of features, should they be required. In conjunction with ACLs (Access Control Lists) and QoS (Quality of Service) mappings it means that extremely fine control can be exerted over traffic and users with the 7102dl.

Tunneling

Tunneling, also known as "port forwarding," is the transmission of data intended for use only within a private network, through a public network, a la a VPN, in the form of a virtual point-to-point link.

The 7102dl supports the GRE (Generic Routing Encapsulation) protocol for tunnelling, a protocol originally developed by Cisco. In a sense, GRE is like IPSec, but doesn't ensure data integrity and confidentiality in the same way IPSec can; a kind of poor man's IPSec then in some ways and less scalable, but it does use less processing resource, since traffic is not encrypted. Using our virtual external network connection over the second Ethernet port, we set up a basic point-to-point tunnel. In practice though, we feel that most users prefer the IPSec VPN route nowadays.

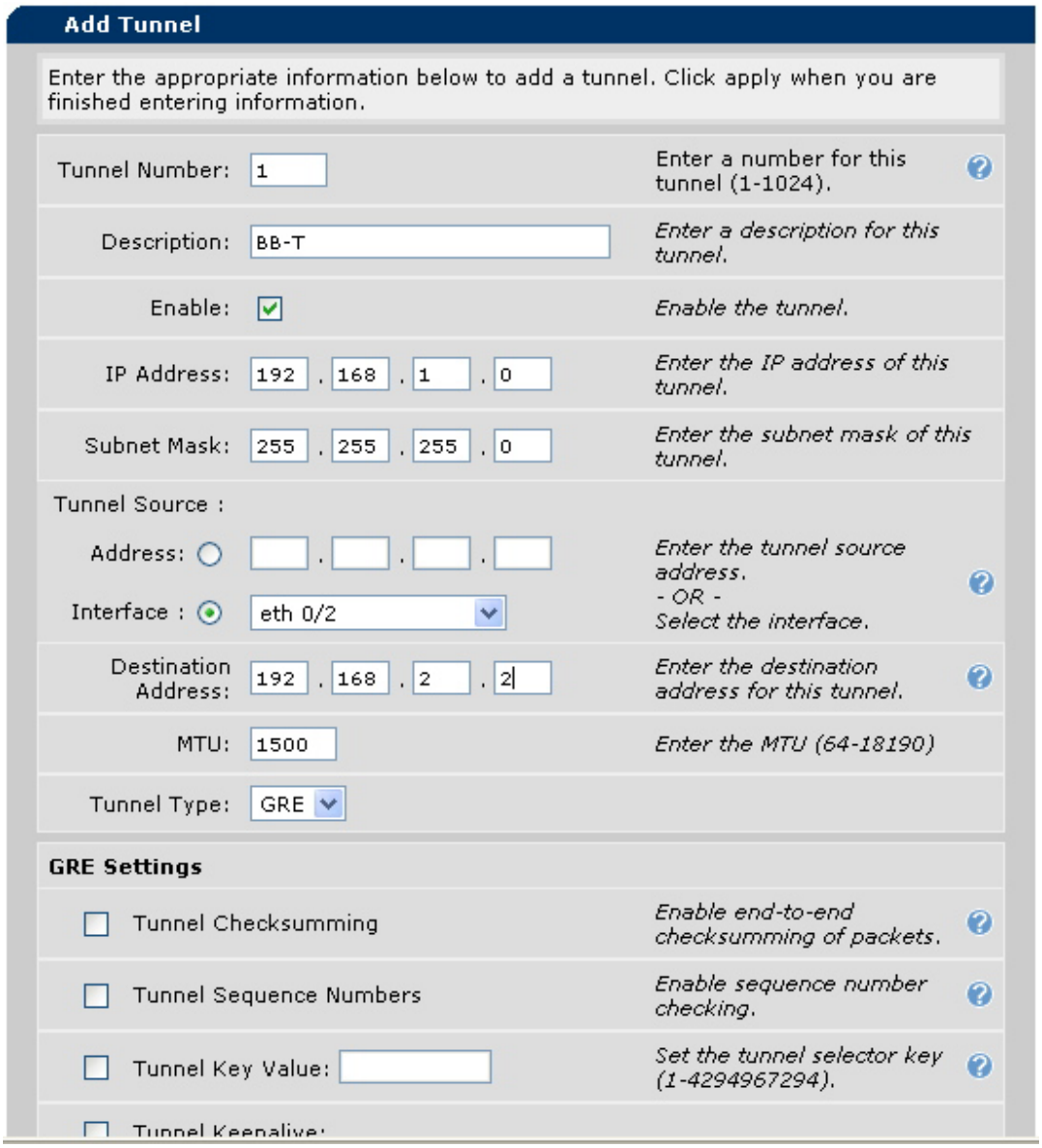

Figure 11 – Setting Up a GRE Tunnel

IPSec VPNs (Virtual Private Networking)

Many users see VPNs as being critical to security in both wired and wireless environments – as we've tested in the past with HP's WLAN solutions. The industry standard IPSec protocol is supported by the 7102dl. Our device came with the optional VPN module pre-installed. As with the firewall, HP provides a wizard option for aiding with an initial VPN installation.

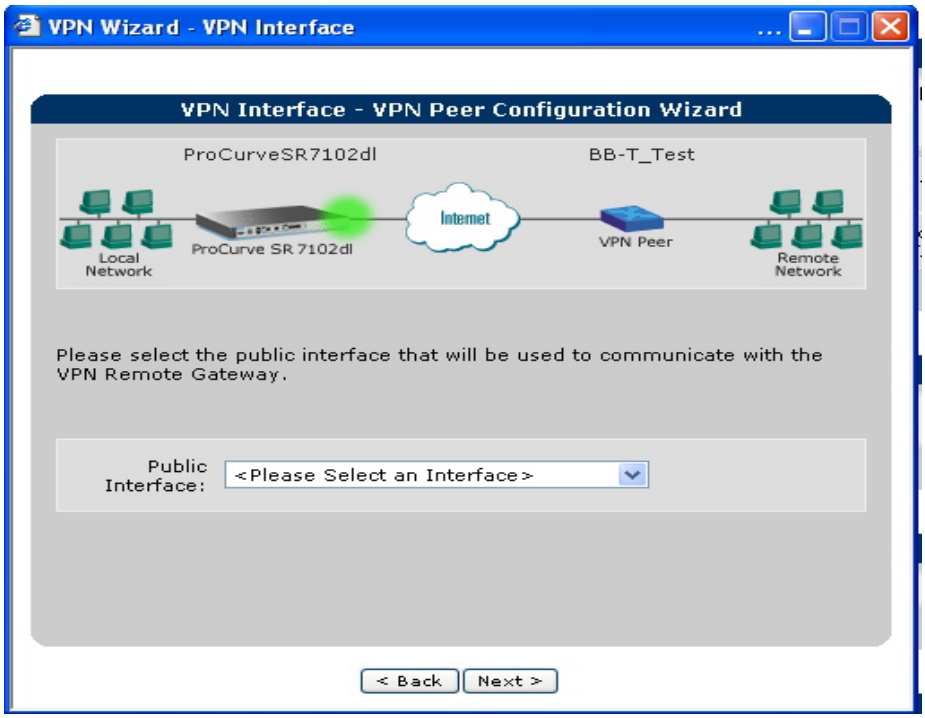

Figure 12 – The VPN Wizard

Again, like the firewall wizard, a graphical representation of the VPN interface you are configuring is shown onscreen. We also made use of a VPN client that HP provided, running on a Windows XP notebook computer.

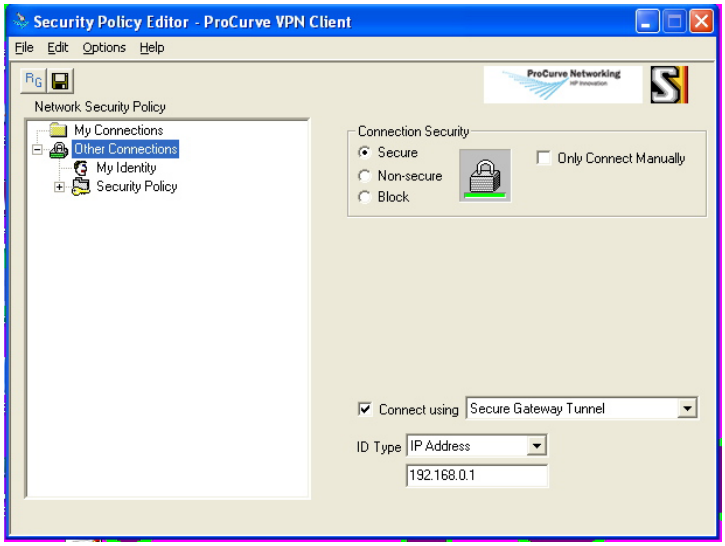

Figure 13 – The VPN Client

Ease of Use And Managed Services: A Perfect Marriage

With many SMBs now looking to outsource some, or all, of their IT requirements, the opportunity for service providers to offer some kind of packaged, managed service for remote access is greater than ever.

For this kind of purpose the ProCurve 7102dl clearly fits the bill from a features perspective; designed for 10-100 users, but with enterprise-level security. However, all that counts for nothing if the initial deployment and day-to-day management of the device is too complex. And here we're not simply talking about the problems for the end user, but the costs associated with those problems and the ever-diminishing profits margins for the service provider as a result.

According to Noel Bruton, a UK-based, independent consultant who advises companies in improving their helpdesk and IT user support services, the time taken to resolve a support call can be from around four minutes for 60% of all incoming requests for help, but can then increase to an average of 37 minutes of actual effort, if there is no immediate resolution. Worse still, that time period may be spread across two days or more of an open helpdesk call. This means that just a single call may cost a service provider in the region of €30 and that is a very conservative estimate. Multiply that by a hundred users making just one call each a month and the cost of that support burden starts to look alarming.

From the service provider perspective, therefore, minimising support calls is the difference between running a profit-making service and one that is simply a major loss-maker. What HP has done with the ProCurve 7102dl, in providing wizards for key elements of the initial installation process, such as firewall and VPN, and by minimising the need for day-to-day reconfiguration of any aspect of the router, is to genuinely reduce the likelihood of a service provider being over-burdened by technical support calls.

From the end-user perspective, it means that the day-to-day costs of operating the device – remember support calls cost the customer in terms of time wasted too – are lowered and expensive, add-on consultancy requirements are minimised or removed completely. So both parties win…

Scalability Tests

Device Saturation Test

Our primary aim here was to see how the ProCurve 7102dl reacted when enabling more and more features on the router, given the same test and same level of traffic each time. We used three different file sizes – 10KB, 64KB and 512KB – and ran the test max'ing out at 100 users. The aim was to saturate the 100Mbps Ethernet connection on the 7102dl and see just how much of this available bandwidth the router could use when under stress.

Starting with only the basic routing functions enabled (R), we then repeated the tests, first with the firewall enabled (R/F), then with the firewall in stealth TCP mode (R/F/S) which makes the router invisible to scanners on ports that are not open, and finally adding a TCP rule to the firewall (R/F/S/RI). In each case, therefore, we were creating more and more processing requirement for the 7102dl to deal with.

We measured both the transaction per second (TPS) rate achieved with each file size in each of the different router configurations, and measured the bandwidth in and out that the router was able to generate.

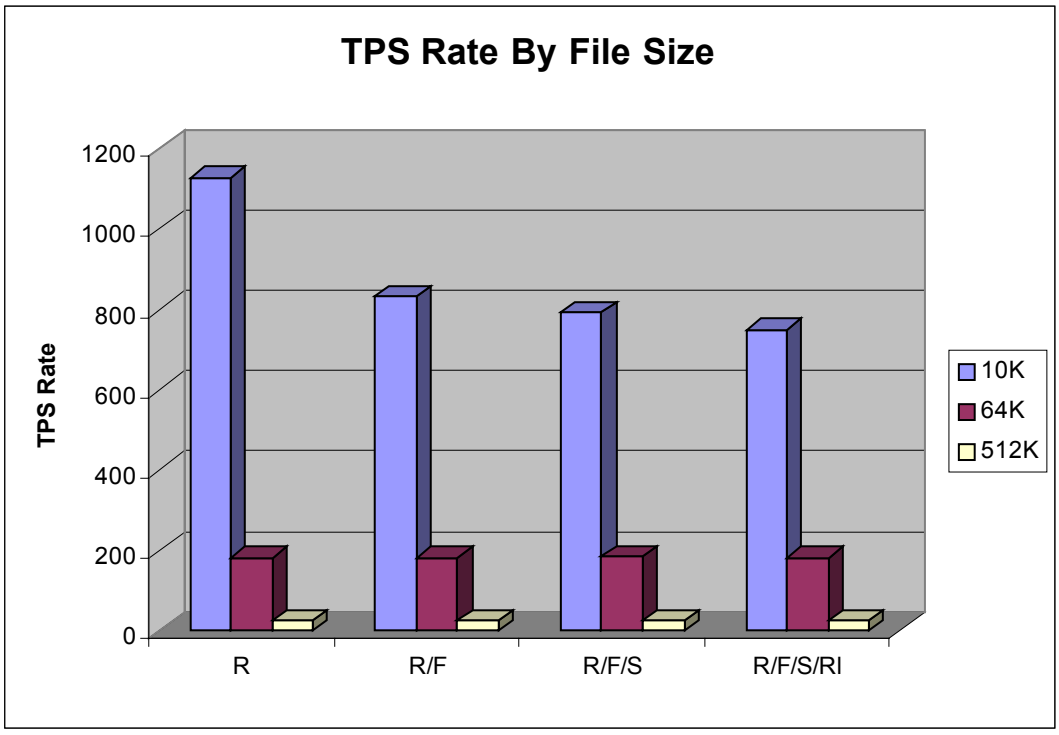

Figure 14 – TPS Scalability Test

We found that, with the larger file sizes, where less physical transactions were taking place, performance held up 100%. Only with the smaller file size – 10KB – did the router performance degrade, and then not significantly thereafter, once the firewall was enabled. This is very typical behaviour for a router – beware those making 100% wirespeed claims; wait until you turn all the features on and see what happens to the performance!

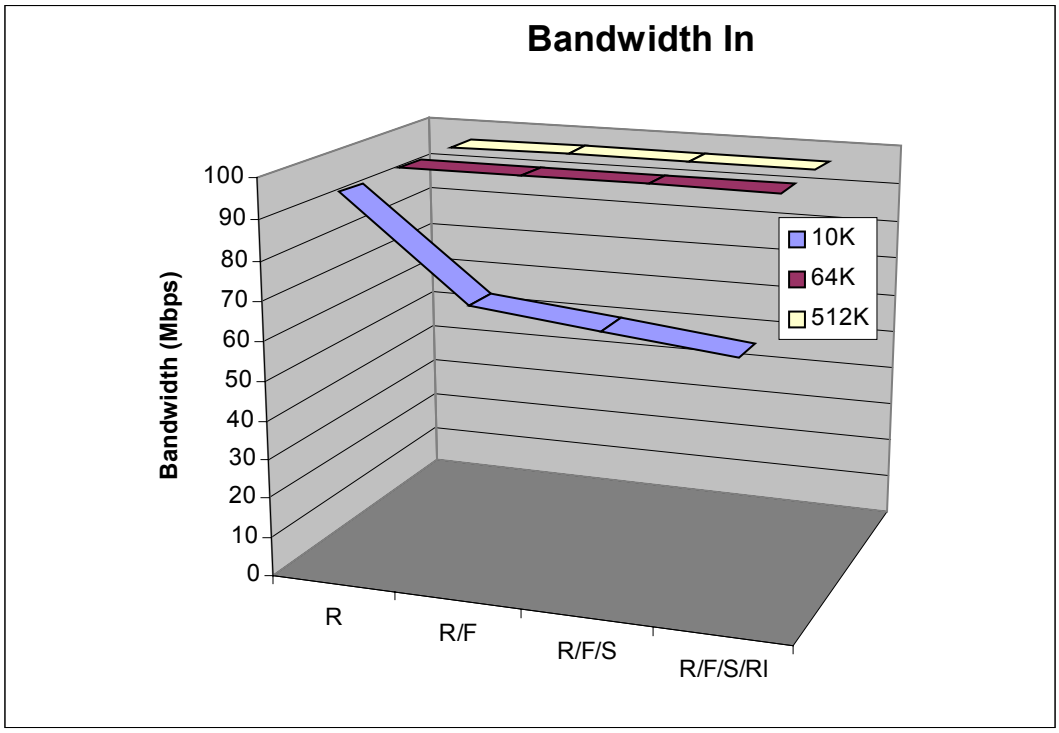

Figure 15 – Bandwidth In Scalability Test

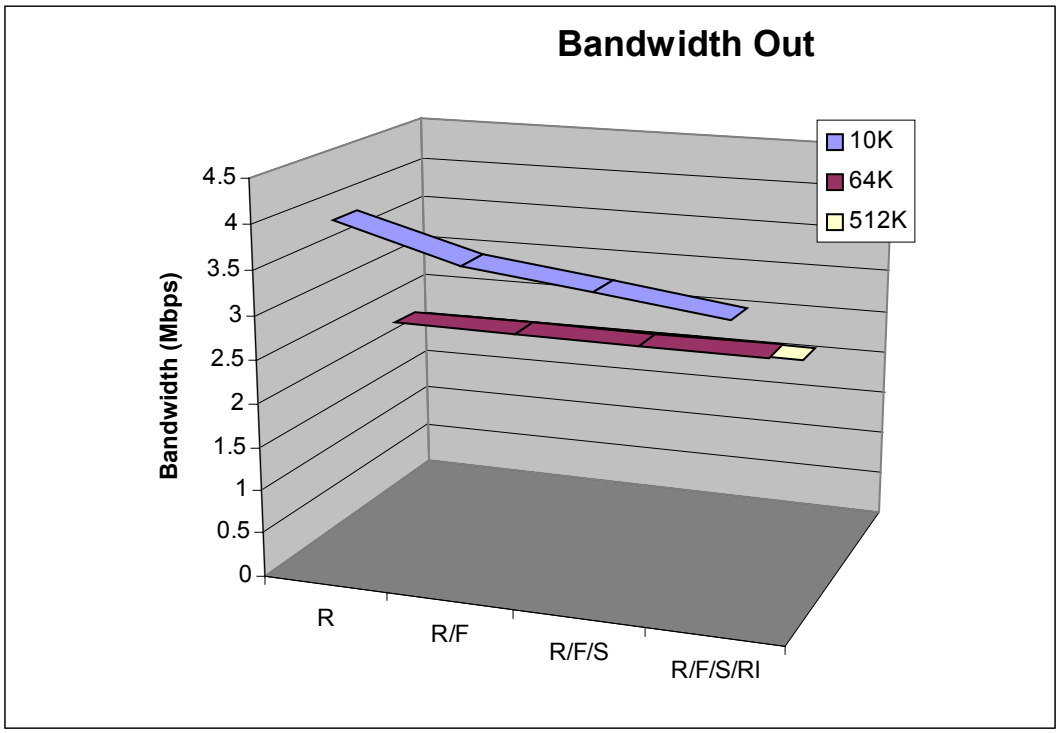

Figure 16 – Bandwidth Out Scalability Test

It was a similar story when we came to measure the simultaneous bandwidth in/out during the test. With the larger file sizes, bandwidth utilisation was absolutely constant, at around 99%. However, with the 10KB file size, it dropped from 100% to as low as 68% with all the features enabled. Again, this was not an unexpected result, but the norm.

QoS Test

We also set up QoS on the 7102dl for a specific real-time traffic test, using the Spirent Avalanche to simulate streaming video sessions (RTSP protocol). With the 7102dl there are several ways to create QoS and bandwidth reservations.

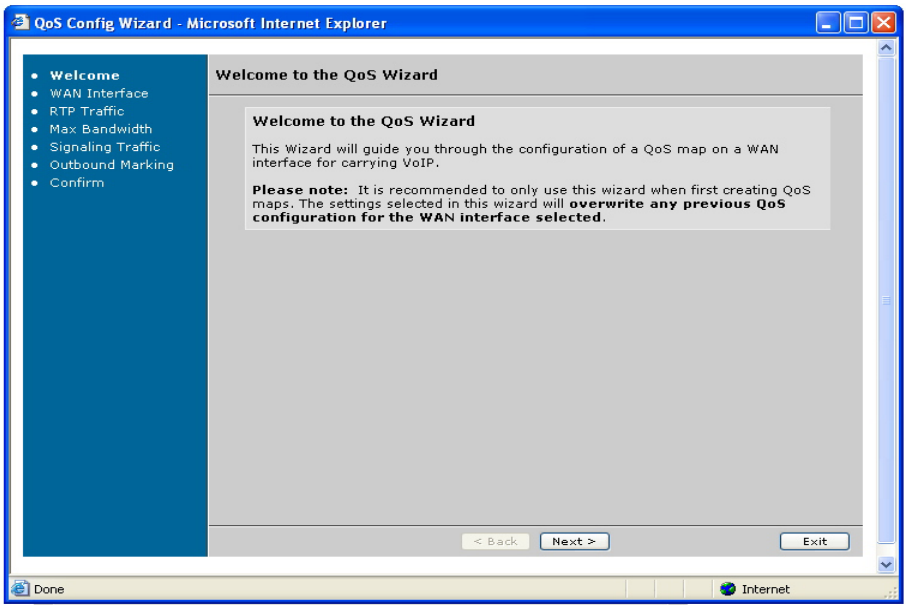

Figure 17 – QoS Wizard

The easiest option is to use the QoS Wizard, which walks you through a couple of screens, allowing you to choose a method of bandwidth reservation, including via an ACL. We tried a number of options, including the ACL, where we specified UDP traffic heading for port 554. In order to do this, however, we had to use the CLI, which we accessed via a Telnet session from the management GUI.

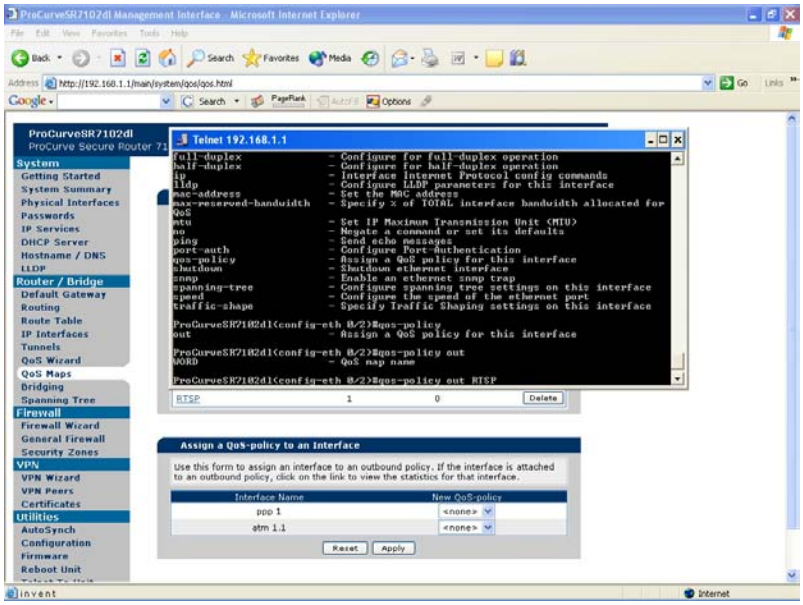

Figure 18 – Creating an ACL at the CLI

The idea here was to set a bandwidth reservation limit – in our case unlimited – for RTSP traffic, run a test with only HTTP traffic, 100 users grabbing 1MB files, then add RTSP users to the mix and see how much http traffic was allowed and how much real-time, video streaming traffic was allowed through. The simulated users were downloading a 60 second video stream that was 250KB in size, so the link was well and truly oversubscribed.

We actually achieved around 96% utilisation of the Ethernet connection; this with the firewall enabled and the ACL rules being activated, which is excellent.

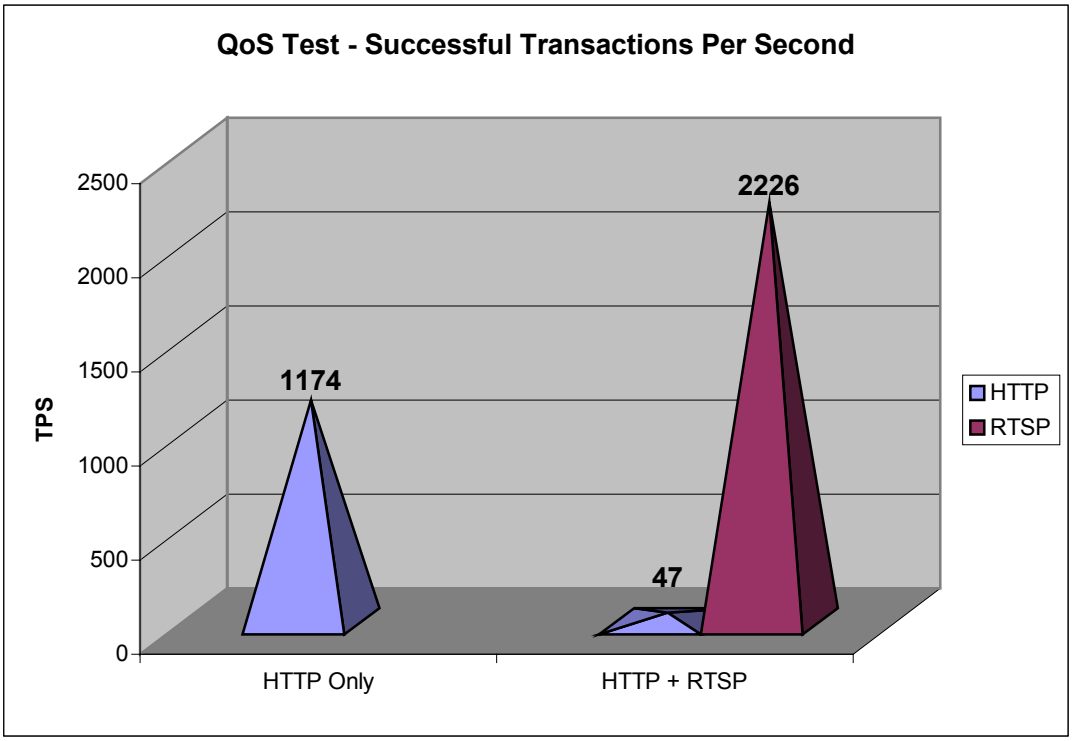

Figure 19 – QoS Test

On the first run, we achieved 1174TPS with HTTP traffic. On the second run, with our QoS map in place and the RTSP traffic added, that HTTP TPS rate went down to just 47TPS while we simultaneously achieved 2226TPS for our streaming video sessions, an excellent result.

SUMMARY AND CONCLUSION

The aim of this test was to prove the ProCurve 7102dl secure router to be a suitable device for deployment in an SMB, branch office, or managed service environment.

To achieve this, we used the router for several weeks in our labs, treating it as our own office remote access router, as well as carrying out a series of tests – feature and performance oriented – both on live Internet lines via our ADSL connection and in a controlled test environment, using Spirent Avalanche traffic generators.

Our primary objective – to test the ease of configuration, deployment and day-to-day management of the 7102dl – was met by the router. The management GUI provides several short-cut methods, via its wizards, for configuring relatively complex features such as the firewall, VPNs and QoS. On the downside, some functions still have to be configured at the CLI, though this is as good as any we have seen. However, on a day-to-day basis, the 7102dl is very easy to live with and should present no problems in any of the scenarios we envisage it being deployed in. The lifetime warranty provided with the product is also hugely reassuring, especially given the projected customer base.

In our scalability and QoS tests, the 7102dl also performed well up to expectations.

Overall then, the ProCurve team seems to have got the balance between simplicity and feature-rich right on this WAN edge device, the 7102dl, which will fit the bill for any SMB, branch office, or managed service packaged aimed at the 25-100 user market.

APPENDIX: TEST EQUIPMENT DETAILS

Internet architectures are becoming increasingly complex.

Whether you're building network equipment or providing a service, you must deliver consistent performance under all conditions. Until now, capacity assessment at high-loads has been a costly and complex process. For this reason, Spirent Communications introduced the Avalanche 2500 and Reflector 2500 appliances to assist with the challenge. At Broadband-Testing we have taken these web application simulation and planning products and integrated them into our test-bed simulating real-life Internet conditions; those that the average user experiences daily.

Figure 20 – Spirent Avalanche 2500

Avalanche 2500 is described by Spirent as a capacity assessment product that challenges any computing infrastructure or network device to stand up to the real world load and complexity of the Internet or intranets The system determines the architectural effectiveness, points of failure, and the performance capabilities of a network or system. Using Avalanche 2500 to generate Internet user traffic and Reflector 2500 to emulate large clusters of data servers, you can simulate even the world's largest customer environments. The system provides invaluable information about a site's architectural effectiveness, points of failure, modes of performance degradation, robustness under critical load, and potential performance bottlenecks. It is able to set up, transfer data over, and tear down connections at very high rates - all while handling cookies, IP masquerading for large numbers of addresses, and traversing tens of thousands of URLs.

Avalanche 2500 initiates and maintains more than a million concurrent connections, each appearing to come from a different IP address. This allows realistic and accurate capacity assessment of routers, firewalls, load-balancing switches, and Web, application, and database servers. It helps identify potential bottlenecks from the router connection all the way to the database. This accuracy is especially critical for gauging Layer 4-7 performance. The ability to additionally simulate error conditions such as HTTP aborts, packet loss, and TCP/IP stack idiosyncrasies can help anticipate-and avoid-significant and previously unknown impacts on performance.

To enable more accurate load simulations across multi-tiered Web site architectures, the system also supports extremely realistic user modelling behaviours such as think times, click stream, and HTTP aborts that cause Web servers to terminate connections while back-end application servers continue to process requests. Configuring in this way is simple as both Avalanche 2500 and Reflector 2500 directly from a desktop browser to set up tests, review feedback in real time, and easily reconfigure test parameters.

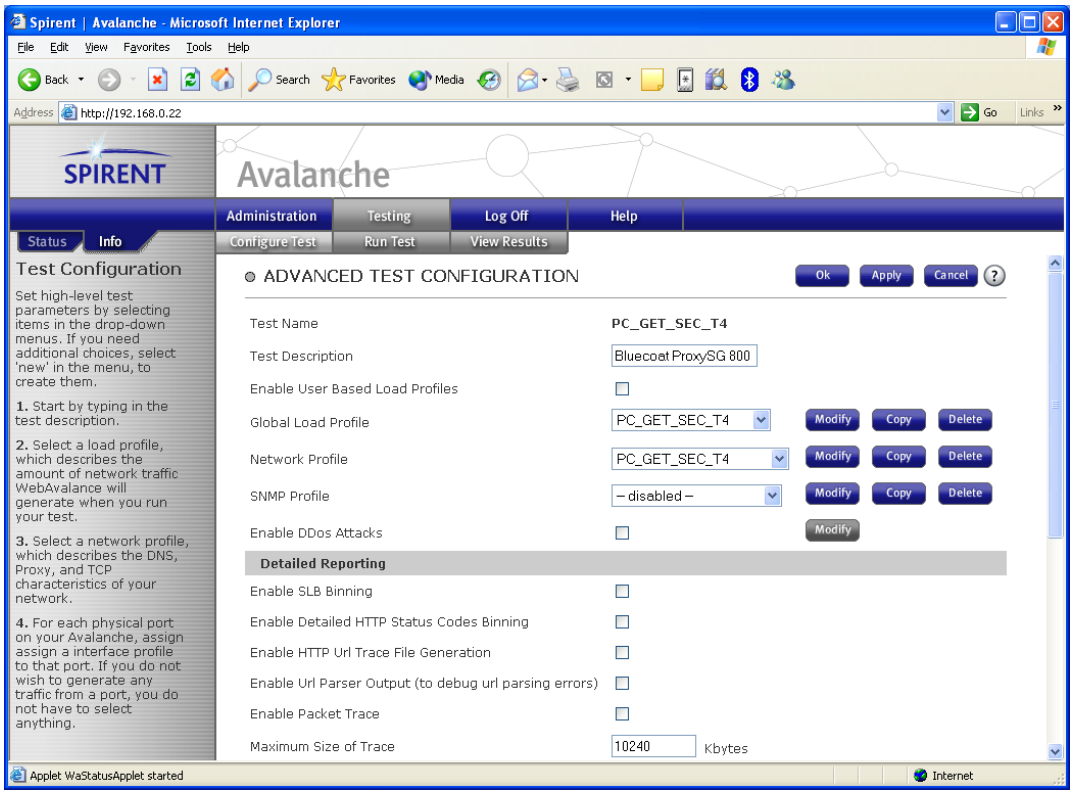

Figure 21 – Creating An Avalanche 2500 Test

The Avalanche 2500 also supports browser cookies, html forms, HTTP posts, and SSL-encrypted traffic. The system therefore gives you the flexibility to specify data sources and mix and match data sets to recreate accurate user behaviour at very high performance levels.

It also simulates SSL loads that can stress the world's most sophisticated secure e-commerce platforms. It also includes configurable cipher suites that enable you to emulate different types of browsers. Avalanche 2500 includes a high-accuracy delay factor that mimics latencies in users' connections by simulating the long-lived connections that tie up networking resources. Long-lived, slow links can have a far more detrimental effect on performance than a large number of short-lived connections, so this approach delivers more realistic test results.

While Avalanche 2500 focuses on the client activity, Reflector 2500 realistically simulates the behaviour of large Web, application, and data server environments. Combined with Avalanche 2500 it therefore provides a total solution for recreating the world's largest server environments.

By generating accurate and consistent HTTP responses to Avalanche 2500's high volume of realistic Internet user requests, Reflector 2500 tests to capacity any equipment or network you connect between the two systems. Its protocol-level accuracy helps you assure the stability and performance of switches, routers, load balancers, firewalls, caches, and other Layer 4-7 devices. The system is ideal for helping infrastructure service providers validate, enforce, and maintain service level agreements (SLAs) as well as the many different applications, such as router, firewall or URL filter testing (see example illustration below).

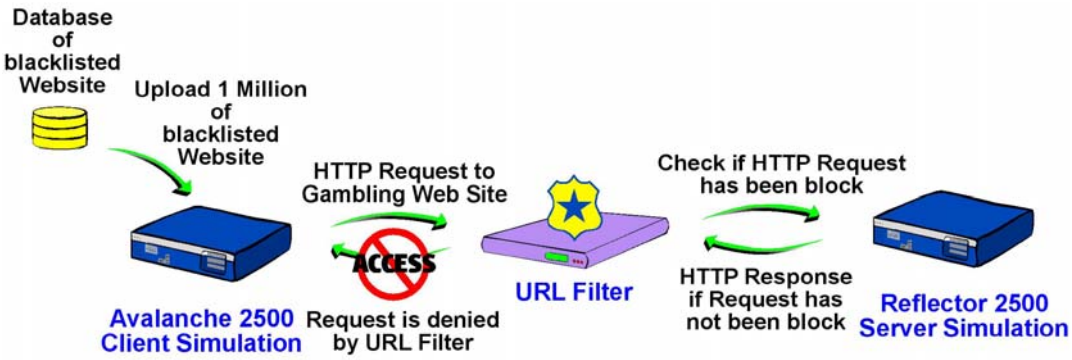

Figure 22 – Typical Avalanche 2500 Test Scenario